THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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IS THE ELECTRICAL ENGINEERING INDUSTRY OVERCROWDED?

A FEW weeks ago we touched upon the apparent overcrowding in all branches of the electrical profession. It is some consolation to learn that other occupations are not in the same unfortunate condition. "England is not overcrowded, and emigration is nearly always implied confession of failure," says Sir Alfred C. Harmsworth, Bart., in the first number of the *Self-Educator*.

There is hope, then, for the overworked sub-station slave with the 'varsity education, who for the munificent salary of 25s. a week, nightly risks his life in an underground electrical death-trap whilst his chief sleeps peacefully, content to know that he can get plenty more shift engineers at the price. The eminent journalistic baronet quoted above would advise the 'varsity graduate to turn his attention to the claims of the motor-car industry. A chauffeur, even, is more handsomely paid, and the work is more exciting and the risks no greater.

From another source, no less reliable, we gather that the electrical profession over in America is quite as overcrowded as it appears to be here in this country. Writing to the *Standard* an American correspondent points out that things there are not what they were. A few years ago there was a great outcry for scientific education. The growth of railways, the enormous developments of electrical engineering, the application of scientific principles to agriculture, dairy farming and many other industries, called for a higher standard of education in the workers generally, and for technically-trained men for positions of responsibility.

The demand for scientifically-trained engineers, and more particularly electrical engineers, was, at one time, so great that it was felt that the supply would never overtake the demand. But it is a very different story to-day: the supply has not only overtaken the demand, but has left it far behind, with the result that large numbers of technical graduates find themselves in a position little better, often worse, than the skilled artisan who has received no technical education at all.

Technical education is not so dependent in America as in this country upon Government grants of money, although these are more than liberal; nor on municipal subsidies, although individual States largely support technical institutes. Over and above such sources of income, enormous sums are subscribed toward the furtherance of scientific education by the large manufacturers, the great railway companies and by wealthy citizens. The result is that thousands of graduates of the technical universities, institutes and schools are annually turned loose to find remunerative employment in some branch or other of the engineering industry.

According to the American Census of 1900 the number of mechanical and electrical engineers in the whole country

was 14,440 ; of civil engineers, 20,155 ; mining engineers, 2,904 ; and of designers, draughtsmen and inventors, 18,956; or a total of 56,453. The number of engineering students in the year 1901-1902 was about 14,000 ; in the year 1902-1903, about 18,000 ; and for the present session it is estimated that no fewer than 23,000 students are taking courses in engineering subjects. It is not to be supposed that these are all freshmen, but assuming that every three years sees a complete change of students, it would seem that about 8,000 technically trained men are added every year to the ranks of engineering. At the low average of £120 a year each, this means an annual increase in the wages or salaries bill of close upon one million sterling.

What becomes of all the men who pass through the technical colleges? According to the *Standard's* American correspondent, America has, in the past, neglected to cultivate a foreign engineering trade, and there is, therefore, no demand for American engineers outside their own country. British engineers, on the other hand, are to be found all over the world, in consequence of the large engineering export trade from the United Kingdom.

Now, whilst it is true that English and Scottish—particularly Scottish—engineers are almost ubiquitous, it is rather to the skilled artisan than to the technician that this remark applies ; as regards the over-production of college-trained engineers, there appears to be the same tendency in this country as in America for the supply to exceed the demand.

It is important, however, considering electrical engineering only, not to overlook the changed conditions ; a few years ago, when electrical engineering was feeling its feet, there was a demand for men with all-round electro-technical training, and such men could generally secure responsible and lucrative positions. To-day the supply is fully equal to the demand, and the era of highly-paid positions is over, for the present at any rate.

Further, the great advance in scientific knowledge, and the increasing use of labour-saving machinery, have raised the educational standard generally, and the artisan or skilled labourer of to-day is to some extent a technical man, and will be increasingly so in the future, so that technical knowledge does not necessarily ensure to its possessor a better position than the non-technical man of the past enjoyed.

Again, the enormous developments in electrical engineering which the last few years have witnessed have given rise to entirely new forms of employment—employment which, whilst not calling for any great skill in handicraft, certainly demands a high standard of general education, coupled with considerable technical attainments. Such men are the successors to the skilled artisans of other days, whose occupations have gone as a result of changing conditions of life and occupation.

It may be argued that a technical workman, who uses his brain more than his hands, should be better paid than the manual worker. But after all, these matters are regulated by the immutable laws of supply and demand, and there are many callings requiring more brain work and manual labour than that of, say, a switchboard attendant, but which are not more remunerative.

Meanwhile, our technical schools, more particularly the municipal institutes—where the classes are either free, or nearly so—are filled with thousands of students, many of whom have not the elementary education necessary to enable them to understand and profit by the classes.

Rubber-Covered Wires for Railway Signalling.

In the States, as well as in this country, rubber-covered wires are practically in the pillory, on account of the causes which we recited at length in a recent issue. The matter has been brought to the front across the Atlantic by a report prepared by a committee of the Railway Signal Association. The committee have rigidly set their faces against adulterants, as is shown by the following suggested tests :—"The vulcanised rubber compound must consist of not less than 30 per cent. of the best grade of fine Para gum, mixed with sulphur and dry inorganic mineral matter only. The insulation must be tough, elastic, adhering strongly to the wire (*sic*), homogeneous in character, and must be placed concentrically about the conductor." Again : "The rubber shall be so compounded, that when test pieces taken from the wire, 2 in. between jaws and 1 in. wide (where possible), are subjected to a tensile test, they shall show a breaking strain of not less than 800 lb. per sq. in., and shall stretch to at least 3½ times their original length. The jaws to be separated at the rate of 3 in. per minute. A piece of the rubber insulation, 4 in. in length, must be stripped from the wire, and marks placed thereon 2 in. apart. The pieces must then be stretched until the marks are 5 in. apart, two minutes' time being consumed in the elongation. Upon being released and allowed to contract, the original marks must not be more than 2½ in. apart. The rubber insulation must be subjected for one hour to a temperature of 260° F., using dry heat, and at the expiration of that time, must be tested for elasticity, elongation and permanent set, and must conform to the specifications therefor."

A table, which we need not quote, lays down standards for thickness of insulation, insulation resistance in megohms per mile, and test pressures for wires of various diameters. It is also specified that "the test for insulation must be made upon all wire without braiding, and after 48 hours' immersion in water at a temperature of from 65° to 75° F., tests must be made with well insulated battery and galvanometer, with not less than 150 volts, and readings must be taken after one minute's electrification." The standard test pressure must be applied for five minutes.

The committee have virtually plumped for pure rubber, in regard to which the analytical chemist is the final referee. They say nothing, however, concerning the demand made upon those employing the wire, in the precautions that they must take to prevent deterioration arising from the almost innumerable external hostile influences. Before dynamo design became an exact science, if, by fault of machining, or other cause, any dynamo failed to give its rated voltage at normal speed, the designer could always curse the grade of iron and send to the store for a larger pulley. Those days have now faded into the limbo of tradition. Very shortly, with the increase in the sphere of the analytical chemist, and an inevitable cheapening of pure rubber, those using rubber-covered cables will be unable to lavish maledictions on the manufacturer in the event of trouble occurring, but must seek their remedies in a proper application and protection of the material they are employing.

Working Metals by Electricity.

It must have occurred to many people who have had occasion to make use of electric heating for the purpose of welding metals, that under certain conditions it might be advantageous to conduct that, or similar operations, under water. A recent article in the New York *Electrical World and Engineer* reminds us that such a process was invented some 12 years ago (British patent 7,226, 1892) by Mr. Paul Hoho, and that although it does not appear to have made much headway in the arts in the intervening period, this is probably due to the fact that not until quite recently have engineers fully realised that the peculiar and special advantages and economies of electric heating are often able to

counterbalance the extra cost of electrical energy over that of energy derived from the direct combustion of fuel. The essence of the Hoho process lies in the fact that the heating current enters the portion of the metal it is desired to heat through water, and that the additional resistance produced in the circuit by the film of vapour immediately formed on the wet surface of the metal induces an intense localisation of heat just on the very spot where it is required. Moreover, since the metal forms the cathode, the heating takes place in a reducing atmosphere of hydrogen, thus rendering possible such operations as soldering under the most favourable conditions. If it is desired to surface-temper all or any portion of the heated metal, it is only necessary to break the current so as to allow cold water to come into sudden contact with the incandescent surface. The inventor claims that the heating can be so minutely localised by this process, and the temperature attained can be so easily controlled, that for small metallurgical operations it is far more economical than any other mode of heat production. Of course, nothing but personal experience can confirm claims of this kind, but the process is so attractively convenient, and withal so simple to carry out now that electrical energy is everywhere available (it should be added that direct current at from 100—250 volts is recommended), that there can be few engineers to whom it would be useful who are not in a position to give it a fair trial.

Statistics under the Workmen's Compensation Act.

The years which have elapsed since the Workmen's Compensation Act first came into force have been productive of plenty of statistics purporting to show the extent to which employers' liabilities for the consequences of accidents have been increased during that time. No statistics, however, which can be compiled are sufficiently ample—except in the case of persons employed by railway companies—to enable one to arrive at the true effect of the Act. This is for the reason that where one case is disputed many others are settled out of Court, and consequently no information can be obtained with regard to them. In the case of railways, however, more complete information can be given. A table compiled from the returns furnished by the railway companies to the Board of Trade shows the amount paid by the companies as compensation under the Act, including payments to insurance companies and to funds under schemes certified by the Registrar of Friendly Societies to cover liabilities under the Act. These amounted in 1904 to £142,387 in England and Wales; to £13,675 in Scotland; and to £6,030 in Ireland. Taking the Board of Trade returns as to the numbers employed, and the average weekly earnings, the amount paid as compensation in 1904 works out at less than 10s. per £100 of wages paid.

While the statistics relating to other industries are not sufficient to enable us to see exactly what burden has been imposed upon employers by the Act, they are not altogether without interest. The number of cases dealt with during 1904 in England and Wales in County Courts was 1,730, the largest number yet recorded. The cases settled by acceptance of money paid into Court numbered 183, as against 92 in 1903; while in addition to cases settled in Court there were 705 cases either withdrawn, settled out of Court, or otherwise disposed of in such a way as not to enable the officials of the Court to state definitely the results. The proportion of cases in which the applicant was successful was 82 per cent. In 557 cases the award was a lump sum, and in 650 a weekly payment. The amount paid for damages in lump sums was £190,000, and the weekly payments awarded represented a total of £1,700. These figures are large enough in all conscience, but are they as large as we were led to expect they would be by those who prophesied that the Act would inevitably place such a strain upon employers, that it would have the effect of increasing the cost of output? In the case of railways, we have seen that the whole cost of the Act involves an increase of but 10s. per cent. in the wages bill. Surely that is not a formidable figure, especially when it is recollected that before the Act came into operation many railway companies had already promoted schemes for the compensation of injured workmen. The statistics above considered will not, it is apprehended, fill the employers with alarm. Glancing for the moment at the other side of the picture, are those who take benefits under the Act satisfied with its nearer and more remote effects? Signs are not wanting to show that employers have methods of protecting themselves against the Act. Although they are not at liberty to compel a workman to contract out of its provisions, they are not bound to employ any workman if through age or physical incapacity they think he is more likely to sustain serious injury by an accident in the course of his employment. Officers of friendly societies have stated that men with grey hairs in their heads are finding it increasingly difficult to find employment. This is one result of that species of legislation which seeks to interfere with liberty of contract.

Lamp Efficiencies.

In the *Electrical World and Engineer* (New York) for October 14th, the subject of lamp efficiencies is reverted to. The recent editorial comments raised a number of criticisms, and clearing away the chaff, says our contemporary, one always returns to the same old question as to what one really means by efficiency. Do we mean the quantity of light given by the expenditure of a given amount of energy, or "do we mean the conception of each manufacturer as to the relative market value of his product?" If the former, the one logical criterion is that of ascertaining the mean spherical candle-power; if the latter, one is landed in a maze of complex considerations and difficulties.

To the mean spherical candle-power method two principal objections are raised, viz., (1) that certain illuminants do not lend themselves conveniently to such measurement, and (2) that light in certain directions is wasted and ought not, therefore, to be taken into account. These objections are critically considered. As to the first, the gist of the criticism is that if the lamp does not lend itself to being thus measured, so much the worse for the lamp. If it has non-luminous ends it has no right to the claim of a high degree of efficiency in certain directions only. As to the second objection, it is contended that broadly and generally speaking to hold that light is wasted in certain directions is sheer nonsense. In the first place, it is not lost because it becomes reflected and diffused; in the second, if light is specially required in certain directions, it can be easily and economically obtained by the use of shades or reflectors. The importance of directed illumination is regarded as being much exaggerated. What are, however, held to be significant considerations are the factors of colour and brilliancy. These may legitimately be called into play in advocating different wares, but they must not be confused with efficiency.

Whilst agreeing with our contemporary's remarks in the main, and whilst in no way wishing to encourage indefiniteness where precision is right and reasonable, we feel that a worthy effort may sometimes be driven too far, and that in this instance the question does not lend itself to too mathematical a treatment. Lamps are chosen in practice, and will continue to be chosen, according to their suitability to meet varying requirements, and in so far as any particular type of lamp proves best adapted to meet such requirements, so it becomes the most efficient, irrespective in many cases of the particular ratio reigning between the energy consumed and light emitted. The determination of this ratio will always be a matter of considerable scientific interest, but, excepting in instances where the total light efficiency varies in a pronounced manner, and becomes manifest in the bill for energy, the question of the exact ratio subsisting in different types of lamps will not constitute the only one of importance in the selection of lamps.

THE GRAPHIC CALCULATION OF DYNAMO-SHUNT RHEOSTATS.

Designing, whether it be of dynamos, regulators, or what not, consists mainly of two operations—the first, planning, for which one requires practical experience of machines and materials; the second, calculating, to be successful in which process (often a laborious one) is to save time by means of all possible short cuts to results, bearing in mind always, however, that this is allowable only when a saving of time can be attained without a sacrifice of accuracy.

The object of this note is to present a method which is a most convenient, simple, and withal accurate "short cut" to the determination of the amount of regulating resistance required by any given dynamo for any required voltage variation, and conversely, the amount of regulation that may be obtained by using a given regulator resistance in the field circuit of a given shunt dynamo, the sole requisite for the determination being the magnetic characteristic curve of the machine in question. This may be the calculated or even roughly estimated curve (if approximate results are sufficient), but is preferably the actual test-curve giving the no-load characteristic of the machine. If this curve has to be obtained by test, and no suitable or sufficient test-resistances are to be had, it is easily managed by using in the field circuit a variable resistance consisting of a bucket of water, with salt or soda dissolved in it, into which a piece of sheet-iron dips, hung from a stick which rests on the top of the bucket. In any case, the curve is to be of the practical form, machine terminal volts plotted against actual amperes excitation; not that the more theoretical forms are not equally useful, but that they are rather less simple and direct in giving the particular result desired. The full-load test curve is not required, as a resistance which will lower the terminal voltage to a given figure at no load will be ample and to spare at full load.

Having the desired saturation curve, A B C (fig. 1), and taking, first, the case in which it is required to determine the voltage regulation obtained on the dynamo by the use of a certain resistance of known amount, from C, the point on the curve corresponding to the normal voltage of the machine, draw C D horizontally. If this line, C D, is divided at E into two parts proportional to the amounts of resistance of the shunt field coils (hot), and the regulator resistance respectively, as indicated, a straight line joining E to the origin O will cut the saturation curve at a point, B, corresponding to the resultant stable voltage of the dynamo with the given resistance in the shunt field.

Thus, in the particular example shown, a regulating resistance equal in amount to the resistance of the shunt field coils (making the total shunt resistance equal to twice the resistance of the coils) will not give a regulation between 500 volts and 250 volts, but between 500 volts and 188 volts; if the regulator has one-half the resistance of the field coils, we only get down to 398 volts (B′); with one-third, down to 436 volts (B″), and so on.

In the converse, to determine the resistance required to obtain a given voltage range, it will be seen that if a line joining the point O, to a point on A B C representing the lowest voltage required, be produced to cut D C, then the proportion between the two parts of D C so cut will indicate the necessary proportion between the resistances of the shunt field and the regulator.

The other method of obtaining these results is to calculate from the volt-ampere curve a second curve of ampere-ohms, which shows the total resistance in the shunt circuit corresponding to any point on the saturation curve. This total resistance curve is shown at G F H, the distance F K representing the regulator resistance, and the distance of H K from the base-line the (constant) amount of the shunt field resistance.

It will be seen, on reference to the figure, that the results obtained by the two methods are identical, but that the ordinary method requires the accurate calculation and plotting of a second curve, whereas the simpler process gives equally accurate results by setting out two straight lines, one of them divided, in any case, by not more than a single setting of the slide-rule. One interesting fact easily noticeable

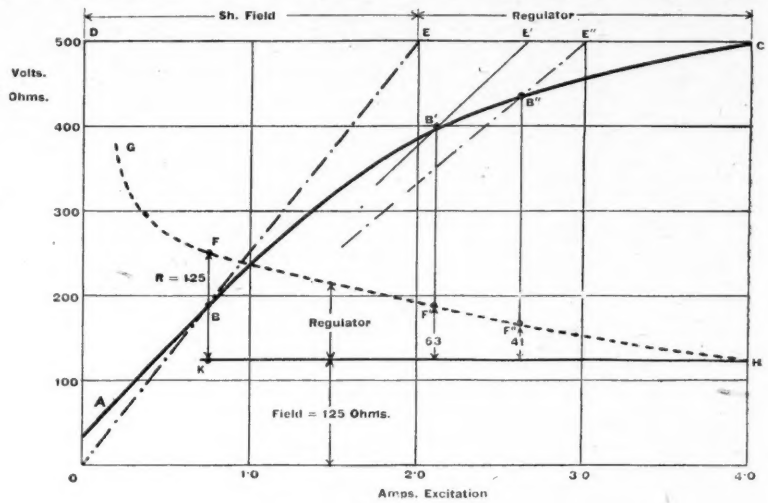


Fig. 1.

when using the simpler construction is the rapid decrease in the voltage of the dynamo for a slight increase in the regulating resistance on the unstable portion of the curve; beyond a certain point, which is also well shown, any increase in the amount of extraneous or added resistance becomes practically useless.

The above graphic calculation may be used also for the determination of the compounding of dynamos for desired characteristics; the particular method of calculation has a much wider application, holding equally good for a variety of curves which depend on three variables, each a function of the other two; this wider utility may well be left, to be worked out to suit individual needs and requirements.

E. W. S.

Large Electrically Operated Swing Bridges.—A description recently appeared in the *Railway Gazette* of the Missouri River bridge of the Omaha Bridge and Terminal Railway Co., which consists of two 520-ft. spans placed tandem, forming probably the largest bridges in the world of their kind.

Electrical energy is utilised both for swinging the spans and operating the signals, these functions being interdependent on each other, so that it is impossible for the operator to perform an operation out of its proper order. An independent circuit on either side of the river supplies energy to the respective spans. The feeders, signal and indicator wires are brought to the operator's house through overhead spans ending in a swivel pole, at the bottom of which is a set of insulated collector rings for making connections at all points in the rotation of the bridge. The swinging of the draw span is performed by two 40-H.P. motors mounted directly on the machinery inside the drum. The end lifts, which are of the wedge type, are moved by two 20-H.P. compound motors, one at each end of the bridge. The rail locks at each end of the bridge are worked by compressed air. The semaphores are operated by primary batteries, the home signals being placed about 500 ft. from each end of the bridge, and the distant signals about 1,000 ft. in advance of the home signals. The railroad line is single track, but the bridge is double track, requiring a double-track signal system. All signals are normally at danger, requiring trains to approach the bridge under control. The entire control of the signal system and the bridge is effected through a single contr lling stand. The levers controlling the semaphores are mechanically interlocked to make it impossible to allow trains to approach the bridge from opposite directions on the same track. Two interlocked controllers are used; the operation of one clears the signals and rail locks, withdraws the wedges and unlocks the other controller, which governs the bridge-swinging operations.

The first controller then remains locked until the bridge is back in its normal position, As an additional precaution, each movement is visually indicated on the switchboard by means of red and white lights. The operator's cabin occupies an elevated position in the centre of each span; it contains the switchboard, controller and an electrically driven automatic air compressor.

ELECTRICAL PROPOSALS FOR PARLIAMENT TO CONSIDER.

Many Interesting Projects.

In accordance with our usual custom at this time of the year, we give below a brief indication of the nature of the proposals which are embodied in the applications which are being made to Parliament for electric light, power, traction, and other schemes. The full text of the application in each case will be found in one of the last four issues of the *London Gazette*.

It will be observed that there are many proposals of exceptional interest beyond those to which we have already drawn attention, particularly in connection with the future electricity supply in the London area. Two Bills are being promoted by a number of existing London companies, whose desire is to mutually assist one another if permitted; several Bills are also being applied for to establish closer relationship between municipal authorities already conducting electricity supply undertakings—apart altogether from the London County Council's own power scheme. Several of the London companies are individually promoting private measures regarding additional powers as to power supply on their own account.

The electrical features of the projects of the Thames Harbour (Board of Commissioners), the Channel Ferry Railway and Quay (Dover), and the London and Brighton Motor Way, are all, to say the least, interesting; and in the Electric Railways section, it will be seen that there are several new lines projected for London. While these are the main points which have stood out prominently before us in compiling our summary, there are others of interest which require the reader to make a close study of the full list. Of recent years each Parliamentary session has produced more important electrical matters for consideration than that that preceded it. Certainly 1906 bids fair to be as important as 1905, if not more so—that is, of course, assuming that all of the schemes are allowed to get to the Committee stage :—

Section I.—Electric Lighting and Power Proposals.

Abercarn.—Provisional order to U.D.C.

Additional Electric Power Supply (London).—New company to generate electricity at St. Neots, easements along River Lee and canals, supply electricity inside and outside London; carrying of cables across highways, streets, railways, canals, &c. (See p. 835, Electrical Review, Nov. 24th, for particulars.)

Administrative County of London and District Electric Power Co.—Electricity supply in Surrey, Essex and Kent and Administrative County of London.

Ascot District Gas Co.—Electricity supply in Old Windsor, Easthampstead and Cookham, and Chertsey; supply in bulk outside area.

Aylesbury.—Prov. order to Mutual Electricity Supply Co.

Bacup Corporation.—Various further provisions respecting conduct of electrical undertaking.

Barry U.D.C.—Amendment of 1901 and 1904 prov. orders, extension of time, and transfer of powers.

Bettws-y-Coed.—Prov. order to U.D.C.

Boston.—Prov. order, National Provincial Electricity Corporation, Ltd., 118, Queen Victoria Street, E.C.

Bournemouth.—Sundry electric lighting and tramway provisions.

Brixham Gas Co.—Electric lighting powers, and supply in bulk; repeal of 1903 Electric Lighting Order.

Bude and Stratton.—Provisional order for Christy Bros. and Middleton.

Calverley.—Application by U.D.C. for extension of time under 1903 order.

Camberley and District (Frimley and Easthampstead).—Prov. order for Camberley Electric Supply Co., Ltd.

Castle Ward, Weetslade and Cramlington.—Prov. order to Newcastle-upon-Tyne Electric Supply Co.

Charing and District Gas Works, Ltd.—Application for electricity supply powers.

Charing Cross, West End and City Electricity Supply Co., Ltd.—Powers for supply in bulk in London and Essex; water from Thames; undertaking not to be subject to restriction of provisional orders.

Cheshunt.—Prov. order to North Metrop. E.P.D. Co., Ltd.

City of London Electric Lighting Co., Ltd.—Power to supply electricity to railway, tramway, canal, navigation and other companies.

County of Durham Electric Power Supply Co.—Further powers; agreements with Newcastle-on-Tyne Electric Supply Co. and other authorities; exemption of fittings, &c., from distress; electric lines under or across the River Wear.

Crediton Lighting and Power.—Dissolution and re-incorporation of Crediton Gas Co., Ltd.; supply of gas and electricity.

Cumberland Electricity and Power-Gas.—New company to generate and supply electricity and power-gas in parts of Cumberland.

Derbyshire and Nottinghamshire Electric Power Co.—Alteration of capital arrangements; agreements with others for supply of electricity to railways, tramways and canals; power to acquire tramways; extension of powers of supply for all purposes in area; erect over-ground lines, &c.

Dorchester Corporation.—Amendment of 1901 order; extension of time; transfer of powers.

Dowlais Gas and Coke Co.—Power to apply for electric lighting provisional order.

East Barnet Valley.—Prov. order to North Metrop. E.P.D. Co. Ltd.

Edgware.—Electricity supply powers to North Metropolitan E.P.D. Co., Ltd.

Exeter Corporation.—Extension of area to include Urban District of Heavitree.

Farsley.—Prov. order to U.D.C.

Folkstone and District.—Powers as to supply of electricity to Hythe and Sandgate by the Folkstone Electricity Supply Co., Ltd.

Foots Cray U.D.C.—Amendment of 1901 order; extension of time; powers as to transfer.

Gelligaer and Rhigos R.D. Council.—Electric lighting powers.

Godalming.—Urban Electric Supply Co., Ltd.

Gomersal.—Prov. order for the Electrical Distribution of Yorkshire, Ltd.

Hackney Borough Council.—Powers as to supply of electricity to or by local authorities of Bethnal Green, Islington, Poplar, Shoreditch, West Ham, Leyton and Walthamstow. Supply of fittings, &c.

Henley-on-Thames.—Prov. order to Mutual Electricity Supply Co.

Hexham and District Electric Supply Co.—Prov. order for supply within the area of the R.D.C. excepting specified parishes.

Higham Ferrers, Rushden and Wellingborough (Rural District).—Powers to Northampton Electric Power and Traction Co., Ltd., as to electricity supply in these districts. Extension of Wellingborough 1900 order.

Horsforth U.D.C.—Amendment of 1903 E.L. Order; extension of time; transfer of powers, &c.

Kent Collieries, Ltd.—Power to establish generating stations and to supply energy; agreements with and powers to S.E. & C. Railway Cos.; supply to railway and other companies, bodies and persons; mains along railway routes.

Kent Electric Power Co.—Enlargement of powers; agreements with companies as to easements for laying cables in Kent and London; supply of electricity to adjoining authorities; transfer of powers; exemption of generating stations from Building Acts, &c.

Lancashire Electric Power Co.—Further powers; exemption of engines, fittings, &c., from liability to seizure; provisions as to transfer of orders.

London County Council.—Powers to supply electricity in County of London and portions of Essex, Kent, Surrey and Middlesex.

London Electric Supply Corporation, Ltd —Extension of area; further bulk supply powers; use of Thames water; exemption from London Building Acts, &c.

London Electrical Supply Companies.—Additional powers to enable existing companies to mutually assist one another by giving or taking supply. [Brompton and Kensington, Central Electric, Charing Cross, West End and City, Chelsea Electricity Supply, City of London Electric Lighting, County of London, Kensington and Knightsbridge, London Electric Supply Corporation, Metropolitan Electric Supply Co., Notting Hill, St. James's, South London Electric Supply, South Metropolitan, Westminster and Smithfield Markets Companies.] To enable any of these companies and the North Metropolitan Electric Power Supply Co., the Kent Electric Power Co., and the Urban Electric Supply Co. to supply electricity in bulk for mutual assistance.

Macclesfield.—Lighting powers—Foote & Milne, Ltd.

Market Harborough.—Prov. order for the U.D.C.

Maryport.—Prov. order to Brush Electrical Engineering Co.

Metropolitan Electric Supply Co.—Extension of limits for supply of energy in bulk and for other purposes (Ruislip-Northwood, Rickmansworth, Chesham, Eton, Slough, Amersham, New Windsor, Chertsey, Egham and Thorpe, &c).

Mid-Durham.—County of Durham Electrical Power Distribution Co. to supply Crook, Willington, Brandon and Byshottles and Brancepeth.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Agreements with Newcastle and District Co. and other companies as to supply and interchange of electricity and many other additional powers.

Newport Corporation.—Additional powers as to electricity supply; supply and hire of fittings; protection of fittings from seizure; apportionment of expenses for electric light and tramway undertakings, &c.

Pinner, Stanmore, Harrow Weald and Edgware.—Lighting powers to Northwood E.L. & P. Co., Ltd.

Pontefract.—Prov. order to Electrical Distribution of Yorkshire, Ltd.

Portland.—Prov. order for Urban District Council.

Ryton Urban District.—Powers to County of Durham Electrical Power Distribution Co., Ltd.

St. Pancras Borough Council.—Continue, maintain and extend their generating stations and other electrical works; exemption from proceedings for nuisance; enlarge, improve, re-build and use refuse destructor.

Seaham Harbour.—Prov. order to S.M.H. Tramways Syndicate (13, St. Helen's Place, E.C.).

Shoreditch and Stepney.—Application of B.C.'s *re* supply of electricity to and by one another, and to and by any authorised distributors in Bermondsey, Bethnal Green, Hackney, Islington and Poplar; joint exercise of electricity powers.

Shropshire, Worcestershire and Staffordshire Electric Power Co.—Further powers; increased capital, extension and division of area, fittings free from distraint, agreements with Midland Corporation for Power Distribution, Ltd. for mutual furtherance of interests; agreements with Kidderminster and Stourport E.T. Co., Kidderminster and District E.L. and T. Co., or Birmingham and Midlands Tramways, Ltd., for amalgamation of interests *re* power supply; alteration of name of company, &c.

Slough and Datchet Electric Supply Co., Limited.—Extension of area; supply in bulk, &c.

South Metropolitan Electric Light and Power Co., Ltd.—Supply in bulk; amalgamation or joint working with electric supply companies; agreements with companies and local authorities, &c.

South Wales Electrical Power Distribution Co.—Capital powers (re-arrangement and additional; payment of interest out of capital during construction).

Stepney Borough Council.—Supply in bulk by and to the Council, and combinations with other Councils for these purposes.

Stourport and Kidderminster.—Power to Kidderminster and District E.L. & T. Co., Ltd., to supply electricity within these urban districts; extension of Kidderminster 1891 order; agreements with local authorities.

Sunningdale and District.—Prov. order to Foote & Milne, Ltd.

Surbiton U.D.C.—Various powers in connection with the electricity supply undertaking; supply of fittings, exemption from distress, &c.

Swanage.—Prov. order to Bournemouth and Poole Electricity Supply Co.

Thames Harbour (Board of Commissioners).—Construction of dam, locks and weir at Gravesend; powers to generate electricity for purposes of the works, and to supply electrical energy; also to use overflow waters for power house, turbines and other works.

Tiverton.—Provisional order for National Provincial Electricity Corporation, Ltd.; Repeal of 1890 order.

Todmorden Corporation.—Powers to refuse electricity supply in certain cases, &c.

Twickenham and Teddington Electric Supply Co., Ltd.—Exercise by this company or Edmundson's Electricity Corporation, of powers and exemption of Hampton and Teddington U.D.C.'s under 1901 E.L. orders; further powers as to supply of electricity in various districts.

Uxbridge and District Electricity Supply Co.—Extension of area to include Hanwell and part of Eton, Beaconsfield, Amersham and Watford.

Wantage and District.—Prov. order for Wantage Engineering Co., Ltd.

Watford.—Electric lighting powers for Watford Gas and Coke Co.

Wealdstone.—Prov. order for North Metropolitan E.P.D. Co.

Wembley.—Prov. order for North Metropolitan E.P.D. Co., Ltd.

West London Electric Undertakers' Association.—Powers to Westminster, St. James's, Kensington and Knightsbridge, Notting Hill, Metropolitan, Chelsea, Brompton and Kensington and Central Electric Supply Companies, and the Hampstead, St. Pancras, Hammersmith and Fulham, to associate with and supply one another with electricity; supply for traction, &c., within and beyond areas of supply. Provisions as to transfer of portions of London Electric Supply Corporation's undertaking in Westminster and Chelsea to St. James's, Westminster and Chelsea Companies. Provisions as to purchase of Central, St. James's and Westminster Companies.

Woodford (Essex).—Prov. order to National Provincial Electricity Corporation, Ltd.

Workington.—Prov. order to Brush Electrical Engineering Co., Ltd.

Yardley Rural District.—Application of R.D.C. for amendment of 1904 order; extension of time; transfer powers.

Section II.—Tramway and Light Railway Powers.

Aldershot and Farnborough.—Amendment of 1902 and 1904 Orders.

Altrincham.—Revival of 1904 tramway powers to U.D.C.

Bath Electric Tramways, Ltd.—Extensions to Light Railways; amendment of 1905 Order.

Blackpool and Fylde.—Application of B. and F. Light Railways Co. for extension of time and other powers.

Branksome Park and Swanage Light Railway.—Baron Alington, T. B. Scott and others.

Buenos Ayres Grand National Tramways Co., Ltd.—Capital and other financial rearrangements.

Bury Corporation.—New tramways within and without the borough.

Canterbury and Herne Bay Light Railway Co.—(Extension of time).

Clayton West and Darton Light Railway.—(H. Kaye and C. Wray—New company).

Dewsbury Corporation.—Revival and extension of tramway powers.

Fairford and Cirencester.—Application by Lindsey Light Railway Syndicate; 8½ miles light railway.

Folkestone, Sandgate and Hythe.—Powers to Sandgate and Hythe Electric Co., Ltd., to acquire existing tramways and construct new; transfer of electric lighting orders, &c.

Folkestone, Sandgate and Hythe.—New company to construct tramways in Folkestone, Sandgate, Cheriton and Hythe.

Halesowen Light Railways.—(Transfer of order, &c.), Empire E.L. and Power Co., Ltd.

Haslingden Corporation.—Tramways electrification; further electric lighting powers, hiring out fittings and exemption of same from distress, removal of obligation to supply "standby" consumers, &c.

Huddersfield Corporation.—New tramways; further provisions as to electrical undertaking.

Kingston-upon-Hull Corporation.—Additional tramway powers; supply of electricity outside the city.

Llanelly and District Light Railways.—L. & D.E. Lighting and Traction Co. Powers for electric lines; overhead wires; agreements as to supply of electricity by other undertakers.

London Southern Tramways Co.—Electric traction powers; and as to purchase of electric energy from existing undertakers.

London County Council.—New tramways in London and Middlesex; agreements with Corporation *re* Blackfriars Bridge; abandonment of tramways; deviation and abandonment of portion of subway; laying temporary raised rails during construction of tramways.

London.—Powers to Corporation to widen Blackfriars Bridge; construction of tramway and other works.

London United Tramways (1901) Co.—New tramways in Middlesex and Surrey.

Macclesfield and District.—New company; tramways in the county of Chester; running powers over other tramways.

Manchester Corporation.—Various tramway constructional and incidental powers.

Mansfield and District Light Railway Co.—Extensions in county of Nottingham; abandonment of part of powers; financial provisions.

Middlesbrough and West Hartlepool Light Railway.—(C. S. Watson and C. E. Straker).

Middlesex County Council.—Various light railways.

Middlesex County Council.—Tramway in Edgware Road; lease to Metropolitan Electric Tramways, Ltd.; agreements with N. Metropolitan E. P. S. Co. as to supply of power.

Newcastle-upon-Tyne Corporation.—New tramways; exclusive right of user.

North Metropolitan Tramways Co.—Dissolution of company and surrender of lease, &c., to L.C.C.

North Wales Central Light Railway.—(Lindsey Light Railway Syndicate, Ltd.), 13-mile line from Mawddwy to Llanuwchllyn.

Nottinghamshire and Derbyshire Tramways Co.—Extension of time; motor-omnibus and other powers.

Oldham and Saddleworth District Tramways.—Abandonment of undertaking and dissolution of company.

Ossett Corporation.—Revival and extension of tramways powers.

Oxford Corporation.—Tramway and motor-omnibus powers.

Portmadoc, Beddgelert and South Snowdon Railway Co.—Two extensions at Carnarvon; also amendment of 1905 Act.

Preston, Chorley and Horwich Tramways Co.—Extension of time; abandonment of part of authorised line; sale of part to Wigan Corporation; carriage of goods; street lighting, &c.

Rochdale Corporation.—Tramway powers.

Romford and District Tramways.—New company to take over powers of the Empire Electric Light and Power Co., Ltd.; extension of time; agreements with authorities as to supply of electricity.

South Lancashire Tramways Co.—Extension of time for land purchase and tramways completion.

Southport and Lytham Tramroad Co.—Extension of time for construction of Southport Corporation Tramways.

Wallasey Tramways and Improvements.—New tramway powers for U.D.C.; supply of electricity in bulk for railways and tramways; exemption of electric lighting fittings from distress, &c.

Warrington and Northwich.—Application by Warrington and Northwich Light Railways Co. for extension of time.

West Cumberland Electric Tramways Co.—Extension of time for tramways and electricity supply; transfer of, and application for, prov. electric lighting orders; manufacture and supply of waste gases and products.

West Yorkshire.—New company to construct tramways and tramroads; take over certain powers from Huddersfield Corporation; power to run over Halifax and Huddersfield municipal lines.

Section III.—Electric Railway Schemes.

Baker Street and Waterloo Railway.—Deviation railway and subways in Paddington; abandonment of part of authorised railway and subway.

Cork City Railways.—New company to construct and work electric railways, taking supply from Cork Electric Tramways and Lighting Co., Ltd.

Cork Link Railways.—New company to run railways to be worked electrically; obtain electricity from Cork E.T. and Lighting Co.

Great Northern Railway Co.—Contribution to cost of generating station erected by Great Northern and City Railway Co., and agreements with that company.

Hammersmith, City and North-East London Railway.—New company to construct railways in London and Middlesex; agreements with Central London, North-West London, and other companies.

London and South-Western Railway Co.—Taking over Waterloo and City Railway Co.; provisions as to sale and distribution of surplus electricity manufactured by company to lessees and tenants of the company.

London Outer Circle Railway.—Construction of railways in Middlesex and Essex; land for generating stations; agreements and traffic arrangements with many railway companies.

Mersey Railway Co.—Omnibuses and motor-cars; provisions as to interest on debenture stocks, &c.

Metropolitan District Railway.—New railways in London and Middlesex; electric working of West London Railway, and numerous other powers.

Metropolitan Railway.—Extension or enlargement of limits of lateral deviation for the improvement of Baker Street Station.

North and South Shields Electric Railway.—Revival and extension of powers for purchase of lands and extension of time; additional capital.

North-East London Railway.—Amendments of Act 1905; additional lands and capital; powers as to payment of interest, &c.

North-West London Railway Co.—Underground railways, Paddington, Marylebone, Westminster, Hampstead, Willesden and Hendon, agreement with Metropolitan Electric Tramways, Ltd., and with North Metropolitan E.P. Supply Co., &c.

Section IV.—Miscellaneous.

Channel Ferry Railway and Quay (Dover).—Agreements with and powers to Corporation of Dover as to supply of electricity.

London and Brighton Motor Way.—New company; land for generating stations for lighting motor way and carriages, stations, buildings, works, &c., of the company, and to motor-cars using the way; to grant power to others to lay conduits or pipes for electricity, telephone, telegraph and other purposes.

London County Council (General Powers).—Supply of electrical apparatus and fittings by metropolitan boroughs.

Metropolitan Pneumatic Despatch Co.—Establishment of system of tubes, cables, generating stations.

Post Office Sites.—(Postmaster-General.)

NOTES ON THE STANDARDISATION OF FUSES.

By ALFRED SCHWARTZ.

The fuse in this country is considered by most engineers to be a tricky and unreliable piece of apparatus; it is often spoken of as if it were on the point of being superseded by the circuit-breaker—presumably in all sizes—and in general it is regarded by the up-to-date man as a legacy from the dark ages (*i.e.*, the transition period between the gas age and the era of electricity), and further, he considers that while it has to be tolerated as a necessary nuisance, it is entirely unworthy of the care and attention that he lavishes upon other portions of his electrical equipment.

For this state of things we have only ourselves to blame; we make our fuses of all sorts of metal, of various lengths and dimensions, we place them vertically or horizontally at will, connect them sometimes to small and sometimes to heavy terminals, arrange the wire in contact with porcelain for the whole or a part of its length, or have it free in air from terminal to terminal, or surround it with incombustible powders of various sorts. We do all these things daily, and have done them these past 15 years, with the result that, up and down the country, the fuse is deservedly vituperated for its unreliability; is it not time, therefore, that we turned our attention seriously to its standardisation?

We are all concerned with the competition of gas, and we labour the point as to relative cost per candle-power-hour, largely forgetful of the other advantages of electricity, of which *safety* is not the least important.

Whenever a fire takes place on premises in which the electric light has been installed, it is in the first instance invariably attributed by the lay Press to "the fusion of the electric wires." In most cases, however, it is ultimately traced to the gas or heating arrangements, but it is none the less our business to ensure the safety of the electric system by a well considered system of fuses, so arranged that their abuse shall be made as difficult as possible, and that their overload capacity shall be of a predetermined value.

Before considering in detail the various points in connection with fuses in which standardisation appears to be desirable, we must clearly recognise that no amount of standardisation will prevent wilful and determined tampering with a fuse. Careful standardisation will, however, reduce this danger to a minimum, by the selection of a form of terminal which will render its misuse as troublesome as possible; while at the same time the ability to obtain from any dealer's stock the standard fuse required would render the legitimate replacement of the fuse far easier than it is at present.

Let us now briefly consider *seriatim* the particulars in connection with which standardisation would be advantageous:—

Length of Break.—The fire risk in connection with fuses should be greatly reduced, first, by standardising the length of break not only for various circuit voltages, but also for various carrying capacities.

The sudden breaking of a heavy short-circuit current by a fuse produces an inductive pressure rise which may be very many times that of the line voltage. This is brought about by the collapse on breaking of the magnetic field due to the short-circuit current; this current if limited only by the resistance and self-induction of the circuit would reach a very high value—possibly from 5,000 to 10,000 amperes on an ordinary service fused for 50 amperes. If the circuit is properly fused, however, it will be opened before the current has had time to mount to the value named above, and the short-circuit current would in the case named be limited to about 1,000 amperes. The greater the capacity of the fuse the longer it will take to melt on short-circuit, and in consequence the pressure rise will reach a proportionately greater value. A standard increase in the length of break with increased carrying capacity should therefore greatly reduce the chances of the persistence of the arc and consequently the fire risk.

Short-Circuit Service.—The term short circuit is a relative one, and the effects which one may get on a consumer's premises connected to a large network are very much less severe than those obtainable on the station bus-bars. Some discrimination should therefore be used in standardising, in order to avoid throwing on the general consumer the burden of the greater cost necessary for a fuse to withstand station conditions. Possibly two classes might be formed, one for fuses (usually of large carrying capacity) to withstand the severe conditions of a true short circuit, the other for fuses (usually of small carrying capacity) for use on circuits of a non-inductive character and of moderate resistance, such as one usually finds in connection with house installation work. As an alternative, some mean condition between these two might be specified in connection with the tests on short circuit with which the fuses would have to comply.

Material of Fuse.—It would appear desirable to specify the material, shape and arrangement of the fuse metal to meet the requirements of circuits which are capable of bearing different amounts of overload. For instance, an ordinary lighting circuit can usually safely withstand an overload of 100 per cent., and it is not desirable on such a circuit that the fuse should come into operation with a less excess current than that named; fuses arranged and rated to meet these conditions might be termed "insensitive" fuses. Arrangements might, however, be made for a further class or classes which would operate with excess currents of from 10 to 50 per cent., and which might be termed "sensitive fuses." Generally speaking, fuses of large carrying capacity would be placed in the latter class. Other points to be considered in connection with the choice of metals are:—

1. The degree of purity obtainable commercially.
2. Resistance to oxidation at the temperature of normal working.
3. Freedom from the formation of an oxide skin of sufficient strength to hold up the metal when molten.
4. The non-arcing properties of the metal vapour.
5. The characteristics on disruption as to the formation of heavy vapours, the degree of scattering of the molten particles of metal, and their condition as to temperature, &c.
6. The contact difference of potential between the fuse metal and the terminals.

7. The coefficient of expansion of the fuse metal relative to that of the terminals or binding screws.
8. The form in which the metal is available, whether in wire or strip, and its capability of being soldered satisfactorily.

Rating.—The normal fusing current for the materials sanctioned should be carefully determined for the requisite ranges and the fuses stamped with the normal carrying capacity, and fusing current and "sensitiveness" expressed as the percentage overload at which fusion takes place, the overload being reckoned as excess over the normal carrying capacity. The time should be specified within which the fuse must blow when started cold with the specified overload; this time will, of course, vary with the capacity of the fuse, and will be greater for enclosed fuses than for the open type.

Testing.—Arrangements should be made for standardising the conditions and details of the following tests:—

1. Normal fusing current.
2. Short circuits.
3. Arcing on fusion with currents slightly in excess of the normal fusing current.
4. Temperature rise for enclosed fuse covers.
5. Insulation between parts.

The normal fusing current for a wire may be defined as the minimum current required to fuse the wire in such a time interval as shall be necessary for the wire to have attained its maximum steady temperature. In order to obtain accurate results, sufficient time must be allowed for this to occur; for open type fuses a method of procedure can be detailed which will ensure this, but for semi-enclosed and enclosed fuses the time interval necessary to bring them up to a given temperature will depend upon the special environment of the wire.

Enclosed fuses are necessarily more expensive than those of the open type, and this has led in the States to their employment without protecting cabinets or covers; it is, therefore, necessary that the temperature rise of the cartridge should not be so great as to cause charring or possible firing of its material or the ignition of any inflammable material that may be in its vicinity. The temperature rise thus specified will, of course, refer to the fuse when carrying the current for which it is rated, and not after short circuit.

This latter condition should be safeguarded by a test to ensure that no molten metal is ejected, or sufficient flame to ignite easily inflammable material on or near the cut-out when only one fuse is blown at a time on short circuit.

Contacts.—There are as a rule two sets of contacts to be considered:—

1. The contact between the fuse wire or strip, and the end plate or ferrule of the holder or cartridge.
2. The contact between the end plates or ferrules of the holder and the clip jaws or terminals of the fuse block.

In some fuses of the open type for fairly large currents, where the strip employed is of sufficient strength, it is forced edgeways between the spring terminal clips by means of an insulated grip handle, which can be removed when the fuse strip is in position, thus obviating one of the sets of contacts mentioned above. With regard to the contacts on the holders in the enclosed type, the fuse metal is usually soldered to the end caps, while in the open type it is usually held under a screw and washer. Where the fuse metal has approximately the same coefficient of expansion as the terminal, not much trouble is experienced, particularly with strip, but where the expansions are different, flattening of the wire may occur, and a loose contact will be developed. Where one of the metals is highly electro-positive to the other, local action will take place in damp situations, with consequent corrosion at the contacts. The form of contact between the fuse holder and the fuse block requires careful consideration; the knife blade and spring clip seems the most promising, as it is simple in construction and avoids the use of screwdrivers for replacement or disconnection, and it will, further, not become loose under working conditions. The only point against it is that it rather lends itself to abuse by the substitution of a strip of metal or wires in place of the fuse holder, but this could doubtless be overcome by a suitable arrangement of the block and terminals.

Spacing.—The regulations under this head should include the specification of the minimum distance separating metal parts of opposite polarity for ranges of fuses of various carrying capacities and voltages. The spacing of the fuses should also be detailed, so as to secure a minimum distance between terminals of the same polarity, to allow of safe and easy handling. For fuses of the open type, incombustible septa of insulating material should be fixed between the fuses to limit the spread of the molten metal; the arrangement should also be such as to prevent accidental short circuit between live metal parts of opposite polarity. Open type fuses should preferably be arranged horizontally rather than vertically, as the arc is less likely to persist; the normal fusing current will, however, be increased by about 5 per cent.

Classification.—Fuse-holders and blocks must be arranged so as to prevent the use of a fuse of a given capacity in a block intended for a fuse of lower carrying capacity. They should also be arranged so that they can only be used on circuits of the voltage for which they are designed. This question of the non-interchangeability for current and voltage will require careful handling, and it may perhaps be found desirable to limit the interchangeability of the fuse by means of a specially profiled attachment to the terminals or holders which could be fairly easily changed by an authorised person should the necessity arise for increasing or decreasing the carrying capacity or voltage of the circuit concerned. Such systems are in vogue in Germany in several forms, and they seem to work satisfactorily. In the United States this non-interchangeability has been secured by varying the distance between the terminals and by allowing a fairly wide variation in current-carrying capacity for a given length between terminals; for instance, with enclosed fuses the range of current-carrying capacity for given lengths between terminals is as follows for circuit voltages up to 250:—

Rated capacity. Amperes.	Distance between contact clips. Inches.
0—2	To be reported on later.
3—30	1
31—60	1¾
61—100	4
101—200	4½
201—400	5
401—600	6

Similar ranges of capacity are allowed with increased distances between the clips for voltages between 250 and 600.

Marking.—The fuse holders or fuses should be plainly marked with the name or trade mark of the maker, together with the voltage, normal fusing current, and rating for which they are intended, and the standard with which they comply.

It is impossible in the space at our disposal to do more than indicate as above the lines upon which, in our opinion, the standardisation of fuses should proceed, but we hope in subsequent articles to deal in some detail with the arrangements in vogue on the Continent and in the United States in connection with this subject.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Regenerative Control.

I am sorry to find, notwithstanding all that I have written in explanation of regenerative motors, that a gentleman of Mr. Crane's education and ability should still be living in a state of Egyptian darkness.

It is interesting to note that he takes the opportunity to modify two of his previous statements, but as he hides himself behind a *nom de plume*, he might quite gracefully have provided the whale with a much larger complement of saloon passengers than is represented by the two moieties of Jonah now on board without landing tickets.

In explanation of the mental problems with which your correspondent is wrestling, I have to say, quite apart from the fact that they have no existence outside his brain pan, that the whole of his letter is based on the logical fallacy of

arguing from the particular to the general. In effect, he says, because I cannot design a shunt motor to produce a certain result, therefore nobody can. If he had put it the other way about, his position would have been invulnerable. "No one can design a shunt motor to produce a certain result, therefore I cannot," but then he would have had to commence by proving the universal negative, which reminds me of Gilbert's delightful way of solving this almost impossible problem—What, never? Well, hardly ever!

In the first place, a regenerative traction motor is not designed on the same lines as an ordinary shunt motor, but it is designed to give the same field as the same motor series-wound, at rated load. At this point the saturation curve is so nearly horizontal that extra ampere-turns produce very little effect.

In the second place, the heating of the shunt field at full load is scarcely worth consideration, because this condition lasts only for a few seconds, and thereafter the current in the field is reduced to less than half and the heating to less than one-fourth.

It will, perhaps, assist Mr. Crane if I tell him that all the regenerative motors now working are running side by side with the same pattern of motor, series wound, and doing the same duty; it is obvious, therefore, that they do not "transcend the laws of nature." Further, there are no troubles with the shunt field and no "kicking coils or other complications" are employed to minimise them.

Incidentally, the error into which your correspondent has fallen, explains exactly the difference between the present successful regenerative system and previous failures, viz., that in all former attempts an ordinary shunt field was employed, whereas, in the new system, the maximum field is practically as strong as that obtained in the series motor.

Mr. Crane says: "It is not, however, the facts which have been published that trouble me so much as those which have not." The ordinary reader will imagine from this that I am suppressing some material information; I think, therefore, it is due to me that Mr. Crane should give some indication of the nature of the unpublished facts to which he alludes.

John S. Raworth.

London, S.W.
November 27th, 1905.

P.S.—Regenerative motors are often called shunt motors, though this description is inaccurate. They are actually separately excited motors, but when regenerating they are shunt dynamos.

A Chance for Motor-Cycle Makers.

I am enclosing a page taken from the current issue of the *Motor*. I think the paragraph I have marked would interest your readers. Comment is needless.

What Next.

VACANCY for pupil in electricity works, new motor-cycle taken as premium. Box 733, care of the *Motor*.

In re Atkinson v. Schmahl.

My attention has been called to the report of the proceedings in the action of Atkinson *v.* myself, appearing in your issue dated November 24th.

Your report is, I think, somewhat liable to mislead your readers.

The contention of the plaintiff was, as you state, that a partnership which at one time existed between us had never been dissolved; my contention was "that it had been dissolved," and this was the issue which the Court had to decide. There never was any question between us as to Mr. Atkinson being entitled to the return of his capital, and before his counsel had concluded his opening statement, an offer was made by him to accept the return of his capital and to give up all other claims.

This offer I accepted, it being the same offer which I myself had made before the proceedings had commenced (nearly a year ago), and we agreed that each of us should bear our own costs.

My leading counsel, Mr. Eve, K.C., M.P., I think, made the matter quite clear in his address to Mr. Justice Swinfen Eady.

In justice to Mr. Atkinson and myself, I trust you will find space in your valuable columns to publish this letter.

A. Schmahl.

London, W., *November 27th*, 1905.

In re L. M. Waterhouse and Patent Acts.
Patent No. 28,632 of 1903.

With reference to the report of the petition brought in respect of the above patent against our clients, the Simplex Steel Conduit Co., Ltd., we only wish to add that, on the advice of Mr. Fletcher Moulton, K.C., and Mr. A. J. Walter, we have already given notice of appeal, and that the order was suspended in the meantime. Prior proceedings had been taken for the revocation of the Bayliss patent referred to, at the instance of our clients, and the petitioners in the present case then consented to the order being taken against them, whereas the validity of the above patent was supported by such well-known experts as Mr. Swinburne and Mr. Barnes.

Glynne Jones & Co.

London, W.C., *November 27th*, 1905.

Re Coloured Cables.

With reference to the letter from your correspondent "H. C. H." in last week's issue, we beg to advise you that cable manufacturers would have no difficulty whatever in supplying a third colour, such as green, if they experienced any demand.

The fact that only two colours are stocked points, we submit, to the absence of any general trade requirements for a third colour.

W. T. Glover & Co., Ltd.
E. L. Baddeley, *Secretary.*

London, S.W.,
November 29th, 1905.

A Death Trap.

In your issue of the 17th ult., under the above heading, I cannot say that I at all agree with "Tin-Tack"; he makes no mention of india-rubber mats, or a telephone by which to get assistance, and these surely must have been there. In regard to the "Chief's" expression, I cannot help thinking that he must have had cause to use the words he did.

C. E. H. E.

[Too much weight should not be attached to the words attributed to the "chief." Most likely they were jocular—certainly they could not have been meant to be taken seriously.—Eds. E.R.]

The letters that have appeared in your columns for the past two weeks have given me courage to bring to the notice of your readers my experience of work in a *private* generating station.

This station is, say, 450 kw. capacity, and runs on the average 14 and 15 hours per day, during which time I am supposed (as chief) to put in at least 12½ to 13 hours.

I have an assistant, it is true, but he is only a wireman, and as he spends most of his time on work outside the station, he is not of much use to me.

The only tools provided are a set of spanners, a few cold chisels, and *one* 14-in. *rough* file; at least, I conclude it was rough when new, but that must be many years ago. All the other tools I'm expected to find myself. With the tools provided (and my own) I am expected to do all sorts of repairs and fitting, from filing up brushes with the aforementioned 14-in. file, to making joints on the steam range with scrap bolts (or bolts that ought to be scrapped).

Now, as I have had 12 years' good general experience in nearly all branches of mechanical and electrical engineering, and only fell out of a good job by the winding up of the

firm I was with, I hardly think I can be called a "shift engineer" working for experience, as "Eight Bells" and others would no doubt try to call me.

I should like to mention that the wage I am getting is under 37s. weekly, and the reason I have to work for this low wage is because it was the only job I could obtain at the time, and as I have a wife and family depending on me, I am forced to do something.

I hope this letter will give others a gentle hint that *sometimes* a man must work for a low wage, because it is the only wage he can get at the time.

When one comes to look at any generating station and the amount of damage that could be caused by carelessness or inexperience, I say it is essential that only efficient men should be employed, and that they should be paid a fair wage.

Rough File.

If you will extend to me your courtesy once again, I should like to reply to the criticisms that my letter in your issue of November 17th has called forth.

First, let me tender my sincere thanks to Mr. Lutken for his sympathetic letter, which is so full of sound commonsense, that I feel it will appeal to all those working in E.H.T. stations, who realise that, unlike cats, they only have one life to lose. I am also greatly obliged for this gentleman's advice, and would recommend a careful consideration of it by those who, like myself, are through force of circumstances, and *not* for "experience," working in similar "death traps."

Letter No. 2 by "Tin-Tacker" is truly wonderful. It is most amusing, and is evidently written by a workman who has acquired a little knowledge, and uses it entirely for vituperation. This, however, is not the subject under discussion; but on one point I should like to enlighten him, viz., soiled hands. As I have served my time, both in mechanical and electrical workshops, and have held positions as varied as mains engineer and stoker on a tramp steamer, I am not afraid of soiled hands and dirty shirts. "Tin-Tacker's" last remark *re* instructions, &c., is too silly for comment.

The letter by "Eight Bells" is a sort of luke-warm affair. He talks about the influx of men like myself keeping wages down, but he must remember that even though several of us are gentlemen by both birth and education (not the Board School education of "Tin-Tacker"), many of us are in very poor circumstances and are compelled to accept the half loaf, or nothing.

I am much obliged to Mr. Ewer for his mention of the E.T.U.

In conclusion, I do not mean to drop the cudgels yet, and if I find I cannot rouse interest enough in the readers of your much esteemed journal, I shall write to the daily Press. I mean to drive my point home about this callousness and utter disregard of human lives.

Tin-Tack.

Addresses Wanted.—A correspondent wants to know the address of the International Telegraph Construction Co., of London and New York.

We should be obliged if Mr. J. G. Halliwell would forward his address.—Eds. E.R.

LEGAL.

British Electric Traction Co., Ltd., and Croydon Corporation.

This case, relating to the Croydon and district electric tramways, was before Mr. Justice Farwell in the Chancery Division of the High Court on Friday. The award made by the arbitrator was in the form of a special case, and related to various agreements entered into by the Corporation and the tramway company. When the matter came on for argument before his Lordship,

Mr. Thomson, for the Traction Co., said that Mr. Warmington, K.C., for the Corporation, said he had arranged that the questions in the case should be considered in a certain way.

Mr. Warmington said he did not see why it should not be stated that the award was in favour of his clients, the Croydon Corporation; and, as he understood it now, the opposition to the award had been withdrawn.

His Lordship: The parties agreeing that the questions should be answered in the negative, the only order I shall make is the simple order as to costs.

Walker *v.* the Ingleton Electric Light and Power Co., Ltd., and Others.

In the Chancery Division of the High Court, before Mr. Justice Swinfen Eady, on Saturday, Mr. A. Grant applied on behalf of the plaintiff for the appointment of a receiver and manager. He stated that this was a debenture-holder's action. The defendants did not appear, but one of the defendants consented, and counsel produced a consent brief.

His Lordship: Are you in a position to take judgement?

Mr. Grant said there was some doubt on that point. The action asked for the appointment of a manager, and the company was in the nature of a statutory one. There was some doubt whether the Court could appoint a manager.

After hearing authorities on the point,

His Lordship appointed a receiver, and said the action must go on.

Liberty was given for the receiver to act at once.

In *re* Letters Patent No. 14,006 of 1903, Granted to J. N. Alsop, and the Patents, &c., Acts.

This case came before the Court of Appeal, composed of Lords Justices Vaughan-Williams, Stirling and Cozens-Hardy, on Saturday, on an appeal by the owners of the patent from a decision of Mr. Justice Buckley in the Chancery Division.

Mr. Haldane, K.C., Mr. Bousfield, K.C., and Mr. J. G. Graham appeared for the appellants, and Mr. Fletcher Moulton, K.C., Mr. Astbury, K.C., and Mr. A. J. Walter for the respondents.

It appeared, from the statement of Mr. Haldane, that the question to be decided arose on a petition for revocation of the patent, which was for a new process of purifying flour by means of electricity, and thus increasing its nutritive qualities. The machine consisted of two parts. By means of the first a powerful current was passed through air, altering its chemical qualities, and the air so treated was then passed into another machine, where the flour was subjected to treatment by it. The process was said to be one of enormous commercial value. The owners of the patent recognised that some of the clauses of the specification, as they now stood, were invalid, and they asked Mr. Justice Buckley for leave to apply at the Patent Office to disclaim that part of the invention which related to a suggested chemical action, which it was now known did not take place. The petitioners opposed the application, and pressed for the revocation of the patent. They submitted that what the applicants proposed to do was not to disclaim, but to correct the specification by striking out incorrect statements, and leaving the invention as wide as it was before. The real invention claimed was for making gluten out of starch by electricity. Mr. Justice Buckley held that the word "disclaimer" in Sec 19 of the Act of 1883 was to be read strictly, and did not include corrections or such explanations as might be required for the purpose of defining the claim. The patentee said that Claim 2 would not produce the result claimed, and therefore he wanted to disclaim by striking out Claim 2. It seemed to him that was not a disclaimer; it would leave the process just where it was, and would not reduce the ambit of the claim. What the patentee sought to do was not within Sec. 19 of the Act of Parliament, and therefore he would not grant the liberty asked. The application was dismissed with costs; hence the present appeal. His Lordship had fixed November 29th for the trial of the petition, so that the applicants might have time to appeal from his present order, should they so desire. The learned counsel said, if the decision in the Court below were upheld, they must go to trial with a bad claim in their patent.

The hearing was adjourned till Wednesday.

Lloyds *v.* The Marconi Inter-Marine Communication Co., Ltd.

This case came before Mr. Justice Kekewich in the Chancery Division on Saturday.

Mr. P. Ogden Lawrence, K.C., for the plaintiffs, said that terms had been arrived at. The arrangement dealt with matters of detail, and therefore he did not think it necessary to mention them. The result was that all proceedings were stayed in two actions, one of which was before Mr. Justice Buckley. They would assume that that action had been transferred to this Court, and there would be one order staying all proceedings on terms initiated by his learned friend, Mr. Warmington, and himself. That would dispose of the action, which, as his Lordship might imagine, would have been of a somewhat troublesome nature if tried.

His Lordship said he saw that was so.

Mr. Warmington, K.C., for the other side, said it had taken a good deal of time to settle the matter, and he thanked his Lordship for the opportunity given the parties to arrive at an arrangement.

The Corporation of Swansea *v.* The National Telephone Co.

In the Court of Appeal, before Lords Justices Vaughan-Williams, Stirling and Cozens-Hardy, on Saturday, Mr. R. J. Parker stated that appeal in this case was pending before their Lordships. It was

a very urgent matter. The action was decided some time ago, and execution was stayed on certain terms. The action was brought by the Corporation of Swansea, which had instituted a telephonic system in the borough. The National Telephone Co. had already a system there. Under the Act of 1899, on certain conditions and terms there was the right of inter-communication between the two systems. The action was brought to establish that right, and the Corporation succeeded. The appeal was from that order. Execution under the order was stayed on the terms, and the three exchanges were to be connected and the inter-connection was only to be used for the local traffic in each case. The Corporation's contracts were all coming to an end, and would have to be renewed in January, and unless they could get this point cleared up before then, it was probable that the Corporation's subscribers would not take the risk of another year, but would subscribe to the National Telephone Co. instead. It was important from the point of view of the Corporation in Swansea that this point should be decided so far as the Court of Appeal could decide it, before the end of the year. He understood that if their Lordships would take it any date after December 11th, the other side would not oppose that being done.

It was ultimately arranged that the case should come into the list on December 11th.

Partnership Disagreement.

At the Colne County Court on 25th ult., before his Honour Judge R. Watson, George Hartley Schofield, electrical engineer, of Railway Terrace, Brierfield, sued George Hargreaves, ex-chairman of the Brierfield District Council, for £12 10s. There was a counterclaim for £49. Mr. Ogden, for plaintiff, stated that on December 15th, 1904, the defendant's son approached plaintiff with a view to the latter entering into partnership as electrical engineers. Plaintiff was not prepared to invest any capital, but became a partner. Subsequently, it was agreed to take a young man, named Foulds, as an apprentice at a premium of £25 for three years. The partnership was eventually dissolved, and Foulds obtained judgement against plaintiff for the £25, the defendant's son having gone to America or Canada. His Honour gave judgement for £12 10s. for the plaintiff, and for £24 10s. for the defendant on the counterclaim, which was for money lent the firm by defendant, and ordered defendant to pay the costs of both actions.

Faversham Corporation *v.* E. Knowles.

At the Faversham County Court last week, Judge Shortt heard a case in which defendant, an E.L. consumer, and a former member of the T.C., was sued for £5 1s. 6d., due for current supplied and rent of meter. It appeared that during the quarter ending June 30th, 1905, the defendant consumed 240 units, for which a charge of 5d. per unit was made according to the scale in vogue. The defendant paid £4 15s. 8d. into Court, this representing 251 units at 4½d., and meter rent. Mr. Knowles, who conducted his own case, contended that in order to benefit by the lower rate he could charge himself for more units than he had actually consumed. The Council's scale of charges was: 6d. per unit to consumers of 75 units per quarter; 5d. per unit for over 125 units; and 4½d. per unit for over 250 units. Had defendant consumed 251 units, he would have had to pay £4 15s. 8d., but as he only consumed 240, he had to pay 5s. 10d. more than that sum. The Judge said the position was very curious, and it would be well if the regulations were altered to meet such a case, but it was pointed out that if the defendant's request had been entertained, the Town Council would have all the consumers doing this, and it would mean a loss. Defendant alleged that the meter was taken in the morning, whereas the quarter ended at midnight. But for that he would have consumed over 250 units. This was denied, and it was urged that the difference of time in reading the meter between the previous quarter was to the defendant's advantage. It was also pointed out that with all his lights on, defendant could not have brought the total of units to over 250 up to midnight. The Judge said that possibly in future the Corporation would make some change in the regulations to provide that when a consumer consumed almost the 250 units and was willing to pay for 250, he might be entitled to the 4½d. charge. At present it was not so. He had simply to interpret the dry law, and plaintiffs were entitled to the 5s. 10d. in addition to the sum paid into Court.

Private Wire and Telephone Installation Co. *v.* Portman & Co.

This adjourned action was heard by Judge Woodfall at the Westminster County Court on Monday. The former hearing was reported in our issue of November 10th. The plaintiffs sought to recover the sum of £30 rent of private telephone. The defendants counterclaimed for alleged breaches of contract from 1901 up to 1905, but his Honour excluded the years 1901-2, and the counterclaim was amended to date from April, 1903, which was the date the contracting department was purchased from the Consolidated Telephone Manufacturing Co. by the plaintiffs.

The plaintiffs were represented by Mr. W. O. Hodge, and Mr. H. Simmonds appeared for the defendants.

It appears that plaintiffs purchased the contracting department of the Consolidated Telephone Manufacturing Co. In 1901 an agreement was entered into between that company and the defendants, under which it was agreed that various private telephone wires should be erected between the offices occupied by the defendants at No. 8, John Street, 110, Strand, 97, Regent Street, and 2, Sussex Mansions, Maiden Lane. The rental for the wires which were installed, was paid at the usual intervals by the defendants, to the Consolidated Telephone Manufacturing Co., and subsequently to the plaintiffs as their successors. However, in March last, the defendants refused to pay rent, and now pleaded that the plaintiffs had not obtained the necessary licence from the Postmaster-General to put up this installation, and therefore there could be no contract.

The Plaintiffs reply to the defence that they had got no licence from the Postmaster-General, was that a licence was not necessary owing to the fact that in the agreement signed by the defendants it was stated that these wires should only be used by themselves or their servants, in which case no licence was required.

Mr. James Leyland Newland, managing director of the plaintiff company, said his company purchased the contracting department of the Consolidated Telephone Manufacturing Co. in April, 1903. They had always experienced considerable difficulty in obtaining payment from the defendants.

Counsel for the defence asked witness if he knew the installation had always been defective.—No.

Before your present company took it over were there frequent complaints?—Yes.

Have there been complaints since?—Yes.

There have been complaints since March, 1902?—Yes.

Verbal complaints have not been made to you personally?—No; but we have a record of them.

Counsel for the defence intimated that he would endeavour to prove to his Honour that the instruments were now worthless.

Witness admitted that they had got no licence from the Postmaster-General.

In answer to Counsel, Witness stated that his company did not fix any 8-b lines. Witness explained that an 8-b line was a wire between two separate firms. They only fixed lines between firms and their branches.

Mr. Fraser, called by the plaintiffs, said he was at one time in the employ of the Consolidated Telephone Manufacturing Co., and he took the order from defendants to install the four instruments. He did not know that the places where the instruments were erected were not branches of the defendants' firm.

In answer to Counsel for the defence, Witness said he did not understand from a Mr. Long that the other firms where the wires were run to should pay half of the charges. Witness admitted that there was nothing to indicate that the places where the wires were run were connected with the defendants. He assumed, however, that all the businesses belonged to Portman & Co., who were simply, trading under a different name.

The hearing was, at this point, adjourned until December 19th.

D. Stewart & Co., Ltd., *v.* Heckmondwike Urban District Council.

This action came on for trial on 22nd and 23rd ult. before Mr. Pollock, K.C., Official Referee. From a report in the *Yorkshire Post*, it appeared that plaintiffs, who were boiler manufacturers, brought the action to recover the price of certain water-tube boilers supplied to, and work done for, the defendant Council in connection with a scheme for lighting the town by electricity. The real point in the case was whether the boilers which were supplied were capable of evaporating 4,000 lb. of dry steam per hour under normal conditions, and with average coal, as specified in the contracts. Defendants said the boilers would not come up to that test, and counter-claimed for damages or set-off. A further point in issue would be as to what was meant in the contract by "normal condition and average coal." The Council's engineer claimed the right to say what were normal conditions, but plaintiffs said the amount of draught in the Council's works was abnormally low, and was insufficient to burn the coal properly. Eventually the Council pulled down the boilers and erected others, and the action was commenced.

Mr. E. M. Downie, director of the plaintiff company, in his evidence, attributed the poor results of a test of the boiler he saw at Heckmondwike to the fact that there was insufficient draught. His firm gave up boiler-making because recently it had become the work of specialists. His company had neither the appliances nor the room to go into the business in the proper way to make it commercially successful. They had sufficient plant to make good boilers, but not cheaply.

The case was adjourned.

The Corporation of Fulham *v.* The National Electric Construction Co., Ltd.

Mr. Justice Bigham, in the King's Bench Division of the High Court of Justice on Tuesday, November 28th, had before him in the form of a special paper for his decision the award of the arbitrator in the case of the Mayor, &c., of Fulham, against the National Electric Construction Co., Ltd., which arose out of the accident at the Fulham Baths on December 23rd, 1902, by which two men were killed by coming into contact with exposed wires which were laid on the tops of the divisions between the cubicles in which the baths are placed.

Mr. Bailhache and Mr. C. B. Marriott were counsel for the Electric Construction Co., whilst Mr. Danckwerts, K.C., and Mr. Maxwell appeared for the Fulham Council.

Mr. Bailhache said the question to be decided by his Lordship was whether or not the Electric Construction Co. was liable to re-imburse the Borough of Fulham the sum of £1,173 odd which

the Borough Council had paid by way of compensation to the relatives of two men killed in December, 1902, in the Fulham public baths. It appeared that on December 23rd, 1902, two men, named William Arthur Line and William Brown, were admitted by the Council to use the baths, and were accidentally killed by the electric shock from a wire forming part of the work carried out under the contract by the Electric Construction Co. Claims were made and actions brought against the Fulham Corporation by the representatives of the men killed, and in each case counsel paid money into Court, which was accepted as satisfaction. The amounts were admitted to be reasonable, but the contractors repudiated liability before the arbitrator, Mr. Jas. Swinburne. The Council claimed to be entitled to recover from the contractors the amount of the charges and expenses paid and incurred by them in consequence of the admitted claims, and the contractors disputed the claim. The grounds on which the Corporation sought to make the contractors liable, Mr. Bailhache proceeded, were that they had committed a breach of contract, which resulted in the deaths of these two men, and were, on the ordinary principles of law, liable to indemnify the Corporation. In June, 1901, the Fulham Borough Council, who owned the baths, wanted an electric light supply, and employed the Construction Co. to carry out the installation, covering the whole of the inside of the baths. There were a number of separate baths, and the system adopted by the architect and engineer of the Fulham Corporation, under whose specifications his clients worked, required a separate circuit to the various sections of the baths. The wires were insulated in the ordinary way, and enclosed in small iron tubes throughout the building; but there was not a continuous system of tubing, the contact being broken at certain points. It was agreed on all hands that where they had a continuous system, and if that system was connected with the earth in one or two places, the whole of the system was connected to the earth. But where there was a non-continuous system it was now agreed that in every section they must have connection with the earth, by a water pipe or otherwise. These two men who were killed at the Fulham Baths were in little cubicles or bath rooms divided from each other by slate slabs 8 or 10 ft. high, on the top of which the electric wire was carried in an iron tube. The first man who was killed, Line, was discovered by his screams, and he was then hanging with both hands to the top of the dividing slab where the wire was. He could not be released until the current was switched off, and he died shortly afterwards. The other man, Brown, was found dead in his cubicle about an hour afterwards, and it was supposed that he had met his death in the same manner. It was admitted that the conduits in both the sections where the men were found were not earthed. It was said that the Electric Construction Co., for whom he appeared, were liable under Clause 20 of the contract, because it was their duty to earth each section of the electric circuit, and that it was a breach of duty not to earth it. He would read the award of the arbitrator, and on that should submit that on the facts found by him, his Lordship should decide in his client's favour. The arbitrator had found, as a fact, that the accident which caused the deaths referred to was caused by the fact that certain iron pipes forming part of the installation were not earthed; he had also found that the Council had spent £1,173 odd on the matters in dispute in the arbitration. The question for the opinion of the Court was whether on the facts stated in the special case, the Council was entitled to recover from the contractors the amount stated. On behalf of the National Electric Construction Co. he, Mr. Bailhache, submitted that he was entitled to his Lordship's judgement. He also submitted that the true facts of the case disclosed no liability on the part of the Fulham Borough Council, who had paid in haste. As to the contractors, he denied that they had committed any breach of contract. It was said that the installation should be according to the rules of the Phœnix Assurance Co., but these only provided that "when it is desirable the metal tubes shall be earthed." The award found that the earthing would not have been "desirable" in so far as the risk from fire was concerned, although it would perhaps have been desirable so far as risk to life was concerned. Therefore, he submitted, there was no breach of duty on the part of the contractors, and if negligence was material to the case it had been negatived by the award. It was said that the maintenance period had not expired when the accident happened, but the arbitrator had found the works were in fact completed. All the contractors' liability, he argued, terminated in April, 1902, or eight or nine months before the accident. The breach of the Phœnix Fire Office rules, he repeated, only applied to the recommendation that earthing was "desirable in case of fire" and did not refer to loss of life. In conclusion, he said that, having regard to the state of electrical knowledge at the time of the accident, nobody could have had any cause to expect damage to life and limb from the installation. The Fulham Corporation was not liable to compensate the relatives of these men, and the contractors were not liable because they were not the injurers.

Mr. Danckwerts: I submit that your Lordship's judgement ought to be the other way.

Mr. Justice Bigham: Do you lose liability from your own contract?

Mr. Danckwerts: Yes, entirely. There is no *tort*. Proceeding, Counsel said he relied on the paragraph in the contract, which said that the whole of the works were to be carried out in accordance with the rules of the Phœnix Fire Office, and because those rules were not complied with there had been a breach of contract on the part of the National Electric Construction Co. He contended that unless it was shown that it was "undesirable," the contractors were bound to earth their installation, and the arbitrator had not found that the earthing was "undesirable" in the sense which relieved the contractors of responsibility. The arbitrator had found that it was not desirable so far as risk from fire was concerned, but that was far from saying that the earthing of the wires of the whole of the sections would not have been "desirable" in case of danger to life. If all the sections had been earthed, the wires would have been rendered harmless, and nobody would have been injured; and the company's officials ought to have known that the use of wires in such a way was dangerous.

Mr. Justice Bigham held that there had been no breach of contract or negligence on the part of the contractors, and that the work was done in accordance with the rules of the Phœnix Fire Office. One of these rules said that when the system of tubes was employed the main tube should be earthed, except in those cases where earthing would not be "desirable." In this case the arbitrator had found that it was not "desirable," and, therefore, he found that there was no evidence of neglect on the part of the Electric Construction Co.—the contractors.

Judgement accordingly.

Mitchell *v.* A. J. Harris & Co.

At the Bradford County Court on 23rd ult., his Honour Judge Bompas, K.C., heard a bankruptcy motion, the petitioning creditor being William Mitchell, Fairfield Road, Bradford, and the respondents A. J. Harris & Co., Ltd., electrical engineers, Bradford.

Mr. Frank Mellor said that the petitioning creditor sought to obtain the rescission of a contract under which the debtor, Mr. Harris, sold his estate, immediately prior to his bankruptcy, to a limited company. Mr. Harris, against whom a receiving order was made on August 18th, 1905, had traded in Bradford as an electrical engineer since 1892, under the style of A. J. Harris & Co. Some two years before his bankruptcy, he borrowed from the petitioning creditor the sum of £500, and no part of that had been repaid. In May, 1905, Mr. Harris was pressed by creditors, and on July 3rd, 1905, he registered a company for the purpose of taking over the business, the share capital consisting of £2,000 in £1 shares. Mr. Harris was appointed secretary, and the company agreed to pay all his debts, which were stated to amount to £957 13s. 3d., including the £500 borrowed from Mr. Mitchell. On July 4th the latter issued a writ for payment of this sum, and the agreement referred to was registered on July 17th. Apart from the payments made by the two directors named for their qualification shares, no capital was brought into the company, the bankrupt holding all the debentures, and his wife 181 out of the 228 shares issued. The trustee submitted that the respondents should be ordered to pay to him the value of the assets transferred to the company. Mr. Mitchell obtained a promissory note when he advanced the £500. Mr. Mellor remarked that it was not necessary to allege any moral fraud, but he urged that the debtor had no right to say that his creditors should not take his assets, and then assign the whole of them to a company, so that the creditors would have to take debentures or nothing.

Mr. H. Newell, for the company, said that Mr. Mitchell would get every penny of his £500, and interest. He had prevented the shares being issued, and had no doubt retarded the life of the company. Mr. Harris had suffered much harm, and he alleged that that was one of Mr. Mitchell's objects. If the money could be raised on debentures, the agreement was the best he could make with the creditors. Mr. Mitchell would have got his money if he had waited a day or two, but he refused to accept any arrangement, and forced things. Mr. Mellor had admitted that the assets were worth £2,000 at the present time.

Mr. Mellor (interposing): I don't give evidence about it; I admit nothing, and I don't deny.

His Honour said there was no evidence that the business was not worth £2,000, and after reviewing the case at some length, he gave judgement for the respondent company.

An application by the trustee that the costs should be allowed out of the estate was not granted.—*Yorkshire Daily Observer.*

Claim by Apprentices.

According to the *Daily News*, Edward Lionel Joseph, Ferry Bridge House, Clifton Road, Maida Vale, was summoned to the North London Police Court on 27th ult. by five apprentices who had been indentured to him to learn electrical engineering, to show cause why he should not pay damages for breach of covenant. The lads were apprenticed by the East London Apprenticeship Fund, and £25 was paid with each. They said that in three or four years they had learned practically nothing. Defendant denied liability, but Mr. Rose said defendant was liable, and ordered him to pay £6 in each of four cases and £2 in the fifth, with costs.

British Pioneer Electric Light and Power Co. of India, Ltd.

In the Chancery Division of the High Court of Justice on Tuesday, November 28th, Mr. Justice Buckley had before him the petition of S. T. Biggs and another for the compulsory winding up of this company. The facts are fully set forth in the following judgement.

His Lordship said this company was incorporated on February 27th, 1899, with a capital of £3,000 in 3,000 shares of £1 each. It had issued all those shares, and had called upon them 15s. a share. It would appear from the petition that 300 shares had been fully paid, and these were held by the petitioners. The operations of the company had consisted in the acquisition of the concession for the construc-

tion of an electric tramway in Bombay and in certain dealings with a sale of that concession. The result had been to produce a sum of £20,000. There had been a return to the shareholders of £6 15s. per share, which, upon shares of 15s. paid, was a return of nine times that which the shareholders subscribed. There were still some further assets. The company, by special resolution passed on the 2nd and confirmed on the 23rd of this month of November, had gone into liquidation. The petition before him was presented by the holders of 300 shares, and was presented on the day on which the special resolution was passed. The petitioners asked for a compulsory order. The petitioners were two gentlemen named Biggs and Sawyer, solicitors. They were mortgagees from a certain Mrs. Bingham, and he was told the 300 shares of which these two gentlemen, Biggs and Sawyer, were now the registered holders were 200 shares which were given to Mr. Bingham as fully paid for certain services, and 100 other shares which he took. It appeared by an affidavit that Bingham parted with these shares to his wife, and she mortgaged them to the present petitioners, Biggs and Sawyer. The case which was sought to be made for a compulsory order was this. It was said that certain transactions which took place during the life of the company had given rise to claims which ought to have been brought against the directors of the company for misfeasance. These suggested claims arose in this way. When this company was incorporated in 1899 and subsequently down to July, 1901, it had three directors and three only. They were Thomas Anderson Kelman, who was the father, and Stuart and Erskine Kelman, who were his sons. And it was said that some time in 1900 a company was incorporated called the Rowell Stuart Kelman Co., Ltd., or the Kelman Co., and that the directors of that company were a gentleman named Mackintosh and the two Kelmans, the sons. The result of that state of things was that the board of that company was Kelman, the father, and his two sons, and the board of the other was Mackintosh and the two sons; and there were dealings between the two corporations governed by these two bodies. So long as the practice continued (which he always deplored) of plurality of office of directors, one was unfortunately involved in this state of things from time to time—where a gentleman as director of one company dealing with another company of which he was also director, was put in a position in which his duty to one company conflicted with his duty to the other. Such a circumstance immediately arrested attention, and one looked to see whether the directors of this Pioneer Co. were guilty of neglecting their duty in giving to the Kelman Co., of which they were also directors, the benefits which were given to them in respect of the concession. On this petition he had not to try whether that was so or not. He was only looking at the facts for the purpose of seeing whether a *primâ facie* case was made out of something which called for the Court to use the power it possessed of making a compulsory order to get the benefit of the section of the Act of 1890, which would enable a public examination to be held in case there was something which ought to be looked into. The transaction was this—the Pioneer Co. were minded to obtain a concession of these tramways in Bombay. There had been certain negotiations, which came to nothing. At a particular stage—the first relevant date was December 16th, 1900—the Kelman Co. appeared on the scene with a suggestion that it was worth the while of the Pioneer Co. to see if they could not get this concession, using for that purpose the services of Mr. Bingham. It was resolved to accept the price of Rowell & Co. and Kelman & Co., which had been made in a letter of December 16th, and he supposed it must be taken for granted that they were to be largely interested in the acquisition of the concession in the terms therein indicated. But there was no bargain made which would have been legally enforceable. There was a correspondence between the Pioneer Co. and the Kelman Co. as to the terms the Kelman Co. ought to have. But he did not find any trace of any improper concession made by the Pioneer Co. to the Kelman Co., originating possibly from the fact of their having joint directors. They looked to be, and he thought they were, real negotiations as between the two companies for the purpose of arriving at the proper terms. He saw nothing to excite suspicion with regard to them. The matter went on, and in June, 1901, Mr. James Anderson Kelman being still the chairman, and the two Kelman sons the other directors of the Pioneer Co., there was a meeting of the directors. The minutes stated that the chairman explained the position of the Bombay concession, and the demands that the Brush Co. were making for a reduction of the price agreed on; the chairman expressed his wish to have the board strengthened in order to deal with this and other matters, and proposed that Mr. Lilley and Mr. Williams be added to the board, and this was carried. At the next board meeting Stewart Kelman and Erkine Kelman resigned, and thereafter the board consisted of James Anderson Kelman, who gave up the chairmanship, Mr. Lilley and Mr. Williams. In order to explain the reference to the Brush Co. in the minutes, he must state that in the interval, this concession having been obtained, there was consideration as to how it was to be carried out. Ultimately, about March terms were arrived at under which the Brush Co. were to buy the concession for £65,000, and to have back £25,000 out of it. That was a circuitous way of saying they were to pay £40,000 for it, and the Brush Co. were to have a certain part of the contract, and the Kelman Co. were to have other parts of the contract. That was the arrangement which ultimately was carried out. What subsequently happened was that the Brush Co. said they had been misled because the concession had been represented to be of a tramway of a certain length, and it turned out to be a tramway of a smaller length. In July, 1901, the board of the Pioneer Co. had become composed of J. A. Kelman, Lilley and Williams. At that time began the friction with Mr. Bingham. On July 10th Mr. Bingham issued a writ against the company, on July 16th the company issued a writ against him. That action came to trial before Mr. Justice Byrne, and the outcome was that Mr. Bingham was not wholly successful. In the interval this had taken place. Owing to the friction that had arisen with the Brush Co., and the claims of Mr. Bingham and so on, there was a negotiation which began on October 15th, and continued to December 10th, 1901. It was of this description: That inasmuch as the figures had to be adjusted with the Brush Co., the figures ought to be adjusted also with the Kelman Co., and they ought to take a proportion of the altered sum. The outcome of that was that the Kelman Co. were giving up the whole of a sum of £15,000 they were to have had, and they were keeping the benefit they got of so much of the contract as was given to them, and they also made a stipulation by this letter that the Pioneer Co. were to adopt the concession note which they gave to Mr. Goode for introducing the matter. The outcome of all this was that the initiation of the matter so far as he could see—although unfortunately it was complicated by having a common director—looked to him perfectly honest. So far as he could see at present, there was no basis for a claim for misfeasance. On every ground, it seemed to him, the petitioners failed in making out their case. He had said but little as to what lay at the bottom of all this. It was quite obvious from the litigation which had taken place between Bingham and the company before that there was active animus and hostility between them, and the presentation of this petition might be actuated by totally different motives from those which the Court ought to give effect to. Were the petitioners prejudiced by the voluntary winding up? Certainly not; they were not prejudiced at all. The petitioners had failed to make out their case, and, on the grounds he had stated, he thought the petition failed, and he dismissed it with costs.

Wallace *v.* J. G. White & Co., Ltd.

Mr. Justice Barton, on 21st ult., granted an injunction against Messrs. J. G. White & Co., Ltd., contractors for the Belfast electric tramways, restraining them from laying poles, lamps, &c., on the lands of Mr. Frank Wallace, at Somerset Avenue, Belfast.—*Irish Daily Independent.*

The Hall Road Railway Accident.

At the Liverpool Assizes on Tuesday, before Mr. Justice Bray, a claim by Mrs. A. M. Sykes, widow of Mr. James Sykes, who was killed in the accident on the electrified branch of the Lancashire and Yorkshire Railway, at Hall Road, on July 27th last, against the railway company was heard. Plaintiff, on behalf of herself and daughter, sought to recover damages for the death of her husband through the alleged negligence of the defendants or their servants. The defendants denied negligence. The widow had received £1,000 in respect of a diary insurance coupon which had been signed. Deceased was in receipt of an income of £216 per annum. Evidence having been heard, the jury found that plaintiff should receive £1,100 from the railway company, two-thirds to go to the mother and one-third to the daughter. The defendants had, however, paid £1,250 into Court. Judgement with costs was accordingly given for the defendant company.

REVIEWS.

Electric Traction. By Robert H. Smith. London: Harper & Bros. 1905. Price 9s. net.

The reviewer regrets that full notice of this important book should have been delayed.

It is twice important: First, as being the best standard work on electric traction for students, if indeed it is not the only work which is thoroughly fit for a text-book; secondly, as an invaluable addition to the scant technical library of the general manager as distinct from the engineer. To the latter it will be as useful as to the student, but to the manager it will come as the first attempt which has been made to bring the commercial aspect into any book. The combination of essays on engineering principles as applied to construction and running, on commercial principles, and finally full descriptions of these principles as they have been applied in actual practice is particularly fortunate, and the author merits the fullest congratulations upon succeeding so admirably in the production of a book conceived on such broad lines.

The preface recognises the difficulty of keeping a book of this kind up to date. It is that difficulty more than any other which has operated to keep down the output of books on the application of electricity in any branch. Would-be authors have been deterred from beginning by the fear that ere the end much of their subject matter would be out of date, but this fate cannot overtake at least one-third of the present volume for perhaps 10 years, while the remainder

will be actively valuable for five, and historically interesting for an indefinite period. It is a book, too, which lends itself to revision, and we cordially hope that Prof. Smith will find his editions flying so strongly that the opportunities for revision will be many. If he does we suggest that the indexing be extended beyond a mere statement of the contents of each chapter. Already we have found annoying the absence of an alphabetical index.

Evidently, the author believes that surface-contact systems have not taken the place they deserve, and may attain in time, for in that part of the book in which are given general descriptions of the various systems of electric traction 55 pages are devoted to the overhead system, and 40 to surface-contacts. Of these 40 pages, 14 are given to the Schuckert system of grouped electro-magnetic switch control, while the Kingsland mechanical system is not even mentioned, and the Lorain system, which, after all, is really in use on 12 miles of tramway, is dismissed very curtly, and somewhat unfairly, in three lines.

For the use of electricity on common roads, *i.e.*, without a rail track, Prof. Smith seems to hope little until the efficiency of the secondary cell is increased. This falls to from 50 per cent. to 60 per cent. after repeated charges and discharges, and the watt-hours per ton-mile average from 140 to 160, but might be improved to 80 or 100.

Prof. Smith is careful to explain that the expression watt-hours per ton-mile expresses a numerical ratio only, being "the ratio between the work done to propel the vehicle any distance to the work that would be required to lift it without friction vertically through the same distance." Therefore it does not involve any reference to distance or speed. This should be remembered when considering figures given by battery makers for automobile batteries.

Estimates, formulæ, curves and tables are given which illustrate clearly the laws governing the cost of running electric vehicles under various conditions of mileage and seating capacity, but the optimistic company promoter should note, if only for his own information, that the data are derived from an assumption that the full complement of passengers is carried in every case.

The "General Survey," which follows the preface, brings very clearly before the student the vastness of the electric traction field.

Chapter 2 deals with tramways in a general manner, being concerned mostly with the economic point of view, and it is this chapter itself which makes the book worth its money. The huge cost of the L.C.C. tramways is thrown at them once more, and a table of 20 columns gives the average results for 1,000 representative miles of overhead tramways, together with the same results for certain individual systems.

The author allows the professor to peep out when he says of the overhead system that it is particularly adapted for the conversion of existing horse lines, "as it involves no necessary alteration or disturbance of the existing road-bed or rail-track, except that required for the bonding of the rails." He cannot be aware that disastrous results have followed this policy wherever it has been carried out, for neither the road-bed nor the rails of a horse tramway are suited to the heavier electric service even when new.

Exception must be taken also to the remarks about guard-wires. On p. 48 it is said:—"The real difficulty is the danger from accidental fall of overhead wires. This is minimised by the use of guard-wires, but the addition of these makes the æsthetic objection . . . . of double force. This difficulty with overhead trams cannot be surmounted." In the first place, the addition of guard-wires increases rather than decreases the danger of an overhead system, because they fall from various causes much more often than the wires which they are meant to guard; and, secondly, it is now possible to guard against falling wires by the use of one wire instead of two; while, thirdly, the difficulty can be surmounted quite simply by removing the message wires to some position in which they will not be a continual menace to users of the streets.

In Chapter 3 occur some useful calculations respecting rail return currents, but something more about negative boosters would be acceptable.

The author will touch a sympathetic spot in most engineers by his proposal to reduce the cost of positive and negative feeders by the use of voltages up to 1,500 or 2,000 on the trolley wire. He states a strong case for this economy, but it is very doubtful whether many of the existing undertakings could face the necessary expenditure for many years, even if there were a chance of the restrictions which limit the pressure to 600 volts being removed. That the change would lead to more accidents we do not believe; in fact, the author is probably right in saying that the safety of the public would be increased because of the disproportionate addition of safety devices which would be compulsory.

Several pages are applied to the consideration of the modified Kelvin law as it bears on the question of cable design.

The second half of the book is occupied by descriptive material. From a study of this, a good idea may be got of the general constructive and working principles of every commercial form of electric traction except the single-phase, which could not have been included, as it was not sufficiently developed at the date of publication.

Although the reader learns it from an early part of the book, we have kept to the last the unpleasant news—stale news to some—that there is no money in the average street tramway if the proper charges are made against depreciation.

The only thing for a given undertaking to do is to prove that it is above the average, and we have not the least doubt that all companies and corporations will be able to deal with this problem successfully for the time.

Cost Accounts. By L. W. Hawkins. London: Gee & Co. 1905. Price 5s.

The author in his introduction states that the object of keeping cost accounts is to enable the manufacturer to ascertain the cost of every article he produces, and of every contract he undertakes. He points out that to be of real value the costs accounts must check against the commercial accounts, as cost accounts, if unchecked, have a tendency to show a result which is more favourable than the true one, a statement the truth of which is now generally recognised.

So far as the wages side of the question is concerned, exact agreement is comparatively easy to obtain, but we cannot account for materials with the same exactness as money, and considerable skill is required to devise a system by which the discrepancy between cost accounts and commercial accounts is reduced to a practically negligible quantity.

The system which the author describes appears to attain the desired end in a satisfactory manner, although we think that with a little modification, such as would occur to a works manager, the clerical work might be to some extent reduced.

With regard to standing charges, or oncost, as the author prefers to call them, we quite agree that these should be regarded as a percentage on the labour cost, and not on the material. It appears to us, however, that to estimate the percentage on each job and enter it in the cost account, as is done by the author, as though it were a correctly ascertained item of cost, is a mere waste of clerical labour. Figures which are practically guesswork are better kept out of one's account books.

The only case in which we require to know with some approach to accuracy the relation which indirect charges bear to prime cost is when preparing estimates for the purpose of tendering. In such a case the cost of labour and material can be foretold fairly accurately, and the percentage to add for indirect charges may be taken from the last trading account or from the average of the trading accounts over a given period.

We agree with the author that it is a great mistake on the part of some manufacturers to use the same rate of oncost year after year, without attempting to check its accuracy or to revise it. Properly arranged trading accounts should be drawn up at fairly frequent intervals in order that the rate of oncost may be periodically checked and, if necessary, revised.

A number of illustrations of forms of rulings are given, and the book is arranged in a most orderly and systematic manner. C. W. H.

Engineers' Turning. By Jas. Horner. London: Crosby Lockwood & Co. 1905. Price 9s. net.

The author of this book is a well-known writer on engineers' tools, both of the small variety, or tools proper, and the machine tool. All machine tools may be said to be derived from the lathe, even including the planing machine.

At first sight it may seem surprising that the slide rest was not invented long before it was. It seems so simple a matter to apply a holdfast to hold a tool, in place of trusting to the workman's hands. But we have to remember that the old lathe bed was first a rough wooden beam. Then it was protected by strips of iron, but it was a long time before it was made truly straight and even, and a slide rest without a level bed to run on was useless.

In this book the author has considered the principles and practice of different kinds of turning, showing various kinds of chucks, and devoting a large section to the modern development of the turret lathe. Boring is essentially a job to be done on a lathe. True, the modern boring mill is a vertical machine, but after all it is but a lathe on end, suitably modified for its new position, and therefore it comes properly within the scope of this book.

Not much is said of the actual lathe, the machine. The reader is assumed to possess a knowledge of the machine. It is rather its working that is here treated of; the methods of doing work, such as the cutting up to a square shoulder, the cutting of a screw thread, and so on. Then the use of chucks in its wider sense forms a proper subject for treatment. Chucks may include so much, and an angle plate is really a form of chuck.

Grinding, tool holders and high speed steel are all treated of, and the young mechanic who gets through this book will be greatly helped in his work. We will quote one paragraph only: "It is a pity that the square necks of the pinions and screws stick out beyond the body in some chucks." It may well be wondered that makers of long standing should be so blind as to continue their foolish and dangerous method of construction, which is on a par with the projecting set screws still seen in connection with shafting and pulleys. As Scrooge might have said, Are there no grub screws? A brief notice of limit gauges is given with Newall's tables, the Newall system of limit gauges having brought the extended use of limit work within the field of practical workshop practice and policy. Considering the variety of fits, the fact that a fit tightness in a long hole must differ from that of a short hole, and so on, the number of individual gauges required in a shop would be legion, and this was the stumbling block to the limit-gauge system until Newall's system was brought out.

Brown's Marine Electrician. By A. E. Larkman and A. Lindsay. Glasgow: James Brown & Sons. 1905. Price 3s. 6d. net.

This is a little book written for the edification of marine engineers, apparently, by two young gentlemen who have gone through a technical course. Like the curate's egg, "it is very good in parts," and would probably be as serviceable to a land engineer as a sea-going one; it is, in fact, principally when the authors discuss matters pertaining solely to electricity on ship-board that they appear to be somewhat at sea themselves. The chapters on "First Principles" and "The Dynamo" are no doubt irreproachable, but why do they include a copy of "Instructions for fixing and working a dynamo," which instructions are intended for the erection of dynamos on land? What on earth, or rather on sea, is the use to a marine engineer of details of concrete foundations, Lewis bolts, and the method of lining up the dynamo to its driving shaft? It is mentioned by the authors that some of the instructions do not apply to ship lighting; but why did they not delete all such instructions, which form a considerable portion of the total? Much of the chapter on batteries might well have been left out, as it is of practically no use to a sea-going engineer. The authors appear to be under the impression that accumulators, when used on board ship, are of the glass box type, similar to those used on land, but deeper, so as to prevent the acid splashing over. There is a chapter, also, on bells, in which the authors show an illustration of the pendulum type of indicator movement. It was scarcely necessary to tell the sea-going engineer that this type is seldom met with in marine work. At the end of the book the authors give us answers to questions set by the Board of Trade in electric lighting. Some of the answers are distinctly amusing. Take Question 5: "What is sparking?" This is described as a breaking-down of the insulation between two points of different potential. "When this breaks down under high pressure the spark is visible as a bright flash. We have examples of this in lightning, also in the opening of a main switch, and occasionally at the brushes of a dynamo"! We do not think it is necessary to quote more from this little book. We can only say that it is hardly one which we should recommend to marine engineers as an infallible guide.—F. B.

The Law and Practice relating to Patents, Trade Marks and Designs. By David Fulton, Barrister at Law. Third edition. 1905. London: Jordan & Sons. Price 12s. 6d. net.

That Mr. Fulton's work on the law relating to patents' trade marks and designs has been welcomed by those to whom it was specially addressed, is shown by the fact that a third edition has already been called for. In its new form the volume is likely to maintain a favourable position among text-books, as it contains a full exposition of the law as amended by the new Patents Act of 1902, the main portion of which only came into force this year. It is well known that many persons looked with disapproval on some of the provisions in the new Act, especially those which vested the Patent Office with new and extensive powers, and it was generally felt that much would depend upon the manner in which these powers were exercised. Used arbitrarily, they might become oppressive, but used with discretion they ought to be beneficial. It is too early yet to pass judgement on the system, as on some points even the officials seem to be at a loss yet to know how to act, but Mr. Fulton gives some information regarding the new practice, and he finds that the officials are showing every consideration for patentees. Patent agents and lawyers will welcome the author's reprint of all the Patents Acts in codified form, which shows at once how the amending Acts modify or replace provisions in the principal Acts. The principal changes in this edition are, of course, in the part dealing with patents, but the author will now have to revise the trade marks section, also to incorporate the amendments made by the new statute of this year.

It should be noted that the title of the volume includes the "practice" as well as the "law" relating to patents, &c., and this is amply justified, for very clear and full descriptions are given on such points of practice as are of common interest or of ordinary occurrence. The extensive indices help very considerably to ready reference by the practising agent, and add to the usefulness of the volume.

BUSINESS NOTES.

Consular Note.—Italy.—The Municipality of Turin has decided to establish plant for the production, transformation and distribution of electrical energy, which is to cost £360,000.

Johannesburg.—Messrs. Newtons, Ltd., of Taunton, last week shipped to the Jubilee Gold Mining Co., Johannesburg, a large generator and two motors of their well-known "Mawdsley" type, together with main switchboard and two controlling panels. This is the third repeat order they have received from this firm during the last few years, proving the suitability of their machines for mining purposes generally in South Africa.

New Lampholder.—Messrs. Millington & Everitt, of 18, King's Parade, Cambridge, have patented a bayonet socket lampholder, in which the live metal parts are almost wholly enclosed in porcelain. The spring contacts can be slipped out for wiring, and easily replaced. The chief feature of the device, however, is a porcelain plug which encloses the plungers almost up to their ends, and is held forward by springs, so that it is free to move with the plungers. We understand that the patent is for sale.

Batteries for Australasia.— The "D.P." Battery Co., Ltd., export department, have booked orders for a 100-kw. battery for Australia, and a small battery of 15 kw. for New Zealand.

Sentences in the Electrical Frauds Case. — The prosecution of Leslie, Cheeseman, Webber and Rosenberg for conspiring together in May, June and July to defraud many electrical firms and obtaining from them goods and money amounting to about £30,000, came to an end at the Old Bailey on Saturday last. Leslie and Webber were each sentenced to five years' penal servitude; Rosenberg to nine months' hard labour; and Cheeseman to twelve months' in the second division. The jury found Leslie, Webber, and Cheeseman guilty on the charges generally, but Rosenberg on the conspiracy count only, and he was recommended to mercy. It will be remembered that the prisoners' methods were the formation of a bogus company—the Electrical Accessories Co.—electrical firms being induced to give orders to that company; acknowledgments of delivery were received from Webber, and the Accessories Co. applied for and received payment. The so-called company was only a name, and the goods were never delivered. During the trial the prosecution gave the following list of some of the payments made to the prisoners during May, June and July:—

	£	s.	d.
May 5—Veritys, Ltd.	150	0	0
,, 6—General Electric Co.	356	10	0
,, 8—Croggon & Co.	222	0	0
,, 15—Evered & Co.	245	0	0
,, 20—Veritys, Ltd.	200	0	0
,, 22—G. Braulik	146	5	0
,, 29—Edison & Swan	245	14	0
,, 29—Electric Co.	194	4	5
,, 30—Brush Co.	192	0	0
,, 30—Sparkes (?)	222	10	0
,, 31—Edison & Swan	720	14	7
June 1—International Electric Co.	212	1	3
,, 8—A. Emanuel & Sons	262	10	0
,, 10—Hands	220	0	0
,, 10—Suter	200	0	0
,, 14—A. Emanuel & Sons	262	10	0
,, 22—Edison & Swan	1,967	2	3
,, 24—Sperati	336	7	6
,, 24—Hale Bros.	180	0	0
,, 26—J. Bolding & Sons	2,000	0	0
,, 27—Hands	218	7	0
,, 27—Evered	661	4	0
,, 27—A. Emanuel & Sons	401	2	0
,, 29—Croggon & Co.	202	16	0
,, 29—Strode	232	15	9
,, 29—Milne	337	10	0
,, 29—Joel	450	8	9
,, 29—Electric Co.	999	2	0
,, 29—Sparkes	500	0	0
,, 29—Purcell	329	7	0
,, 29—Rashleigh	337	15	9
,, 30—Croggon & Co.	210	0	0
,, 30—McGeoch	132	10	0
,, 30—J. Bolding & Sons	2,093	16	3
,, 30—Webber	100	0	0
July 1—Maple (?)	329	1	3
,, 1—Falk, Stadelmann	324	0	0
,, 1—Roger Dawson	610	13	0
,, 5—Gent & Co.	606	18	9
,, 6—Purcell	232	3	11
,, 7—Sunbeam	206	0	0
,, 10— ,,	200	0	0
,, 14—White	232	10	0

Charing Cross Electric Athletic Club.—This club held a walk at Chiselhurst on Saturday last, November 25th, starting from the Crown Hotel. The distance was originally intended to be 10 miles, but as the start was made rather late, it was altered to eight miles with the following result:

SCRATCH RACE.—Malcom Smeaton, 1 hr. 14 min. 45 sec., first; G. Conner, 1 hr. 15 min. 10 sec., second; C. Hilbert, 1 hr. 16 min. 10 sec., third.
SEALED HANDICAP.—F. Palmer, first; H. J. Henbrey, second; Fuller, third.
VETERANS' PRIZE.—T. Jones.
SILVER MEDAL.—H. A. Miller.

Smeaton went off with the lead at the start, and although Conner made up ground in good style in the last two miles, Smeaton retained his lead and won by 80 yds. Tea and a smoking concert followed, the chair being taken by Mr. Percy Mossop, supported by Messrs. J. Fiddes Brown, W. B. Thorpe, and E. S. Harpham. Mr. E. Wilmot Seale, who was prevented by illness from presiding, sent a letter wishing the club every success.

Key Engineering Contracts.—The following contracts have been placed with the KEY ENGINEERING CO., LTD.:—

Manchester Electricity Committee: Supply and erection of a Harris-Anderson feed-water purifier for their Bloom Street works; and 6,000 yds. of fibre conduit.
Melbourne Corporation: 10,000 yds. of 3-in. fibre conduit.
Salford Electricity Committee: 6,000 yds. of fibre conduit.
Oldham Electricity Department: 3,000 yds. of 2½-in. fibre conduit.

Italy.—La Società delle Officine Elettro-Ferroviarie is the name of a company which has just been formed in Milan with a capital of £60,000 to manufacture plant for electric railways and tramways.

Brush Contracts.—The following new contracts have been booked by the BRUSH ELECTRICAL ENGINEERING CO., LTD.:—

For the Bournemouth Corporation.—Five double-deck cars, each mounted on two Brill trucks with Westinghouse motor equipments; one store van and breakdown car.
For J. H. Tozer & Son.—One first-class main-line coach.
For the Cordoba Railway.—Two locomotives.
For the Taff Vale Railway (per Manning & Wardle).—Three motor-coach bodies.
For the Portsdown and Horndean Light Railway (per Diesel Engine Co.).—100-KW. slow-speed traction dynamo.

Government Contract.—In our issue of November 17th, on page 804, we published a notice under heading "Government Contract," referring to an order which was stated to be received by Messrs. Newtons, Ltd., from H.M. Government. We are informed that this contract was secured from H.M. Office of Works for the complete plants, by MESSRS. BROWETT, LINDLEY AND CO., LTD., who sub-let the generators to Messrs Newtons.

Refuse Destructor at Auckland, New Zealand.—We understand that the Meldrum refuse destructor at Freeman's Bay was formally opened on Friday, October 6th. It comprises four grates with a central combustion chamber, and is similar to the three destructors erected by MESSRS. MELDRUM BROS., LTD., for the Johannesburg municipality. Combined with the destructor is a Babcock water-tube boiler having 1,966 sq. ft. of heating surface and capable of evaporating from 3,000 to 6,000 lb. of steam per hour according to the quantity of refuse available. The whole of the steam at 200 lb. pressure will be fully utilised for electrical purposes. The destructor is of the top-fed regenerative type, and is provided with all the latest accessories, including lifting gear for the handling of large carcases, which can thus be readily dropped into the combustion chamber with the minimum of trouble. Tests are now being conducted with a view to ascertaining precisely how much steam will be available for electrical purposes, and it is hoped that ere long Auckland may have a combined electricity works as satisfactory as that at Christchurch, where Messrs. Meldrum erected a destructor about three years ago.

Sentence.—At Stoke-on-Trent on November 22nd, Richard Massey was sentenced to a month's hard labour for obtaining money by false pretences. His *modus operandi* was to represent himself as an employé of Messrs. Blackburn, Starling & Co., electrical engineers, of Hanley, and to call at houses to execute work on electric bells, and to take away old batteries, which he renewed and sold to other persons. By this means he had lived for nine or ten months.

Book Notices.—"Science Abstracts." Sections A and B. No. 95, November 25th, 1905. Vol. 8, Part II. London: E. and F. N. Spon. 1s. 6d. net, each section.

"Bulletin of the Imperial Institute." Vol. III., No. 3, 1905. London: The Imperial Institute.

"Proceedings of the American Institute of Electrical Engineers." Vol. XXIV., No. 10, October, 1905. New York: The Institute, 95, Liberty Street.

"The Application of Electric Motors to Machine Driving." By Andrew Stewart. Third edition. London: S. Rentell & Co. 2s.

"Telegraphy: A Detailed Exposition of the Telegraph System of the B.P.O." By T. E. Herbert. London: Whittaker & Co. 6s. 6d. net.

"Report of Interstate Astronomical and Meteorological Conference held at Adelaide, South Australia, May, 1905." Adelaide, S. Australia: By Authority.

Weldite for Tram Rail Joints.—A new company, WELDITE, LTD. (41, Castle Street, Liverpool), has acquired certain patents and improvements, by which metallic oxides are reduced to a metal under high temperature. The system is claimed to simplify and cheapen the production of metals from their oxides. The material used for this reduction has been named Weldite, and may be used for the production of high temperatures, by which, for instance, rail joints or other bodies of steel or iron can be fused or welded together with but little previous preparation and a low cost for outfit for doing the work. The company claims to practically eliminate the joint, and is anxious to bring Weldite under the consideration of tramway managers and engineers.

Trade Announcements.—Carrying to a logical conclusion the desiderata expressed by Mr. Vicarey in his paper on "Storage Batteries," read before the Faraday Society in July, MESSRS. R. W. VICAREY, LTD., storage battery experts, have now transferred their laboratories to Clun, in Shropshire, where the atmospheric conditions are as nearly as possible conformable to the requirements indicated. The laboratories will be under the immediate care of Mr. Vicarey. For the convenience of clients they have opened offices in London at 15, Queen Street, Cheapside, under the charge of Mr. E. Brettell-Vaughan, F.C.S., where consultations can be held. The Stafford premises will be retained for the present for the convenience of customers in the Midlands as a receiving depôt, but it is requested that all samples be sent to Clun direct, thereby facilitating the execution of their analysis.

Mr. N. C. WOODFIN, A.I.E.E., announces that Mr. John William Helps, who has been acting as his manager, is now no longer in his employ. Mr. Woodfin will continue to carry on business under the style of Woodfin & Co., at Excelsior Electrical Works, 13, Old King Street, Broadmead, Bristol.

Mr. GEO. C. BOOTH has commenced business as an electrical engineer, at 28, Silver Street, Whitby.

The new address of MESSRS. BROOKS, LTD., makers of single-phase motors, is Colne Road, Huddersfield.

Warming and Ventilation at Drury Lane Theatre Royal.—The management of the Theatre Royal Drury Lane have adopted a system of warming and ventilation on the most approved lines. The component parts of the plant are as follows:—A boiler, 14 ft. long × 5 ft. diameter, requiring about 5 cwt. of coal per hour; four large centrifugal fans, the aggregate weight of which amounts to about 3 tons; four electric motors, representing a total of 33 H.P.; two air-filtering screens revolving in water, having a total filtering area of about 400 sq. ft.; two separate sets of heating apparatus for raising the temperature of the air to the required degree, and consisting of between 3 and 4 tons of cast-iron and steel tubing; and combined with these a large number of ducts for convening the warm air. The *modus operandi* is as follows:—Fresh air in large volumes is continuously being drawn through the filter screens and over the heating apparatus by means of the electrically-driven fans, which discharge the warmed and fittered air through the various ducts into the theatre in such a way that it has the effect of raising the temperature of the whole house, thus securing the comfort of visitors without subjecting them to direct currents of air.

Fresh air—warm or cold, according to requirements—is being continually pumped into the theatre by one set of fans, whilst another large and powerful set are employed in extracting air from the building, the result being that within a very short time the whole of the air in the theatre is entirely replaced by fresh, filtered, warmed or cooled air. The work has been carried out in accordance with every requirement of the L.C.C. by Mr. R. Hancock, engineer, Charing Cross House, W.C.

Dissolutions and Liquidations.—British Textile Design and Electric Card Cutting Co.—Voluntary liquidation has been resolved upon, and Mr. F. H. Lee, 3, Market Street, Bradford, is liquidator.

Frizell Bros. & Louis (electricians, 79, Denmark Hill, Camberwell).—Partnership of G. F. Frizell & E. C. Louis, dissolved as from October 23rd.

British Miller Syndicate, Ltd.—Creditors must send particulars of debts to Mr. E. H. Stringer, 110, Cannon Street, E.C., the liquidator, by December 30th.

Catalogues and Lists.—General Electric Co., Ltd., London.—The complete catalogue just issued from the press by this company can justly claim to be described as a standard book of reference for British electrical firms, for it embodies particulars of practically everything electrical, from a terminal screw to a complete central station equipment. Large numbers of our readers have made a very general and continuous use of former editions, and they will be anxious to secure a copy of this 1905-6 edition. The first thing that strikes us as we handle this work is the largely increased size, as compared to the last edition—bulky as that was—for we understand that it contains over 500 more pages than the last, and it exceeds 2½ in. in thickness. So far we have only had time to hurriedly glance through the book, but it contains 13 different sections, each representing a different department. The arranging of these sections has been carried out in a very comprehensive manner; particulars of all goods likely to be required in connection with one another, appearing in close proximity, in order that no time may be wasted in having to make cross references. Two of the new sections which will, no doubt, be of considerable interest, are "P" and "X." "P" section will serve to give some idea of the rapid strides which the company has made at its Witton Works in regard to large apparatus. This section consists of nearly 200 pages, and is devoted to prices and particulars of continuous current, single and polyphase generators and motors, combined sets, boilers, engines, lifts, &c., and it also contains a number of very good pictures illustrating some of the large central station jobs carried out by the company. "X" section deals with large switchboards and switch panels of every description, and also contains a number of pages illustrating some of the company's important installations. The indexing (general and numerical) and general arrangement, appears to be more complete and comprehensive than ever, and we believe that no detail has been overlooked which may happen to be conducive to the convenience of persons continually using this list for reference purposes. From statistics supplied by the General Electric Co., we understand that there are some 148,500 sq. in. of paper used in connection with each of these catalogues, whilst the actual length of paper—if all the pages were torn out and placed in one straight line end to end—would be over ¼ mile. The weight of the list is 10 lb. This will give some little idea of the enormous amount of time, trouble and expense which were necessarily lavished upon the production of this catalogue, which promises to be of great value to electrical firms and companies. Our readers should write for a copy and judge for themselves as to its value.

Messrs. E. Darton & Co., 142, St. John Street, London, E.C.—Catalogue (48 pp.) illustrating and pricing a variety of electrical novelties, motors, dynamos, battery sets, bells, telephones, flash lamps, magnets, and so on.

Messrs. Elliott Bros., Lewisham.—Pamphlet (L.I. 56) describing and illustrating their new leakage indicators to comply with the Electricity in Mines Regulations, their method of use, &c. Diagrams of connections for different circuits appear.

The General Electric Co., Ltd., London.—Small pamphlet giving full particulars of the "Coates" patent magneto-ignition apparatus constructed on the high tension principle. Diagrams of connections are given, also a note of prices.

Mr. C. R. Heap, 28, Hatton Garden, E.C.—List No. 14, giving prices of starting switches for direct current motors.

Mr. Leslie Miller, 93, Hatton Garden, E.C.—Several new illustrated leaflets, detailing (1) Miller's patent jointless section winding for induction coils and transformers; (2) jointless-section induction coils; (3) jointless-section patent step-up transformers for X-ray work; (4) list of hospitals in London using Miller's X-ray induction coils.

The Armorduct Manufacturing Co., Ltd., London, E.C.—New illustrated circular of the "Little Hustler" variable speed electric drill, which has been already described in our pages.

Sterling Telephone and Electric Co., Ltd.—Small priced pamphlet (No. 103), with a charmingly taking cover, particularising the "Sterling" secret intercommunication telephones.

The London Hydraulic Power Co., Westminster.—16-pp. pamphlet on the subject of "Lifts: Hydraulic Power *v.* Electric Power."

Messrs. Mather & Platt, Lld., Salford Iron Works, Manchester.—Fourth edition of catalogue particularising their two-cycle gas engines. Some notes regarding "Körting" gas engine installations that have been in operation for some time are given, together with excellent half-tone views of these plants, which include the Lackawanna Steel Co., of Buffalo, iron and steel works in Glasgow and Germany, an English chemical works, and a flour mill near London. Tables of sizes are given, also a list of these engines, of from 250 to 2,000 b.h.p., which have either been made or are now constructing by Messrs. Körting Bros. or their licensees for various purposes in different parts of the world.

Messrs. Ferranti, Ltd., Hollinwood.—Catalogue No. 51, giving prices, &c., of double-pole, single-throw, quick-break knife switches, for from 25 to 1,400 amperes.

Messrs. Thomas Parker, Ltd., Wolverhampton.—New circulars, Nos. 1A and 2B, just issued. The former contains a well-illustrated specification of belt-driven multipolar dynamos; the latter deals in a similar way with their continuous current motors, showing examples of their application to various driving purposes.

Big Order for Switches.—The Hart M'F'G. Co., of 25, Victoria Street, S.W., has received an order for 2,000 push switches and 500 receptacles and plugs of the "Diamond H" flush type with Louis XVI. face plates in antique gold finish, for the Hotel Ritz, Piccadilly.

American Electrical Exports.—Returns just to hand show that the value of the electrical machinery exported from the United States during September last amounted to only £93,176, as contrasted with £98,483 in the corresponding month of 1904. On the other hand, the shipments of electrical appliances advanced from £69,884 to £77,377. Canada is at present the best market for American electrical machinery.

For Sale.—Tenders are invited by the Senior Official Receiver for the purchase of patents of the Leslie Walker Instantaneous Fire Detector and Fire Indicator Co., Ltd. The Leeds Electricity Department is offering 1,000 second-hand electricity meters for sale. See our advertisement pages to-day.

Bankruptcy Proceedings.—Gerald E. Leslie.—A sitting of the London Bankruptcy Court was held on November 24th, before Mr. Registrar Brougham, for the public examination of Gerald S. Leslie, electrical engineer and caterer for public amusements, Hampstead. Under examination by Mr. G. W. Chapman, Official Receiver, the debtor stated that by profession he was an electrical engineer, but his failure was the outcome of litigation, and the only creditors were the petitioner and his (debtor's) solicitor, the two debts amounting to about £350. He took various halls throughout the country as an amusement caterer, and had been interested in penny-in-the-slot automatic machines, but they had been stopped on the ground of gambling. Last year witness took a piece of ground at Portsmouth, and let it to a roundabout proprietor, it being agreed that witness should provide a wild beast show. That he failed to do, and his tenant refused to pay the rent, with the result that he took an action to recover the rent, and the tenant counterclaimed for damages for breach of contract. Each party gained their point, but the balance was found to be against witness, and he was made bankrupt in respect thereof. He had since paid his solicitor's bill in full, and had given the petitioning creditor 14s. in the £. The examination was concluded.

A. E. Brooks.—An application for an order of discharge was made on Wednesday to Mr. Registrar Giffard, at the London Bankruptcy Court, by Arthur E. Brooks, electrical engineer, 110, Cheapside, E.C., trading as Brooks & Brooks. Mr. C. A. Pope, Assistant Receiver, reported that the failure occurred in October, 1904. Proofs of debt were made to the amount of £2,345, the estate had realised £36 13s. 9d., and a first and final dividend of 2¾d. in the £ had been paid on debts for £460 1s. 2d., a proof for £1,700 having been withdrawn. In 1901 the bankrupt commenced business at 110, Cheapside in partnership with Mr. S. O. Cook as electrical engineer, under the style of Brooks & Brooks, into which business the bankrupt put £150 borrowed money. In 1903 the bankrupt's partner left him, and the bankrupt subsequently continued the business alone until the date of the receiving order. He estimated in his deficiency account that between April, 1903, and the date of the receiving order he made a profit in this business of £113 2s. 1d. He had admitted, however, that the only book of account kept for the purposes of this business consisted of one recording his customers' accounts. The bankrupt had been interested in other businesses not connected with the electrical trade, and he attributed his insolvency principally to his liability as guarantor of debts relating to those other businesses, and for which he began to be sued towards the end of July, 1904. It was not until that happened that the bankrupt became aware that he was insolvent. As offences the Official Receiver reported (1) insufficiency of assets to pay 10s. in the £ to the creditors; (2) imperfect book-keeping; and (3) contributing to the bankruptcy by rash and hazardous speculation. After hearing the bankrupt in support of the application, the learned Registrar upheld the Official Receiver's report, and suspended the discharge for the minimum period of two years. Order entered accordingly.

Robson, Robson & Co.—At the Newcastle-on-Tyne Bankruptcy Court, on the 23rd ult., George Robson and John Samson Robson (carrying on business under the style of Robson, Robson & Co., at Newgate Street, Newcastle-on-Tyne, as electrical engineers) came up for their first public examination in bankruptcy. John Samson Robson, in the course of his examination by Mr. Gourlay, the Official Receiver, stated that they had returned a statement of affairs, which showed gross liabilities of £5,441 4s. 9d. and a deficiency of £3,040 4s. 4d. The assets included a sum of £788 14s., which, he said, was owing upon a completed contract at Liverpool, and which was in dispute. He and his partner commenced in 1901 with £250 borrowed money, which was still owing. As they went on they borrowed more money, amounting in all to £800. He attributed their failure to losses on contracts and heavy interest on borrowed money. He thought it would be 18 months since they commenced to experience serious

losses on contracts. Previous to this they had only had small jobs. They launched into the larger business to get better prices, but it had been attended with persistent loss. The Official Receiver remarked that experience seemed to have taught them nothing; labour was consistently under-estimated. The debtor said that that was not so on the face of it. According to their profit and loss account, down to May, 1903, they were all right. In May, 1904, they had a loss of practically £500, and since that date they had lost on contracts and depreciation £1,500. The debtor contended that they got good prices for their contracts, and expected to pull themselves up at the end. Geo. Robson, having corroborated his partner's statement generally, the examination was adjourned.

December 13th is the last day for receiving proofs for intended dividend in *re* A. Holmes and A. McCallum (Holmes & McCallum, electrical engineers, Darwen). Trustee, T. Hindle, District Chambers, Darwen.

G. W. Leather.—At the Sheffield Bankruptcy Court on 23rd ult., a receiving order was made on a creditor's petition against William George Leather, of 25, Howard Street, electrical engineer, trading as the Windus Electric Co.

LIGHTING AND POWER NOTES.

Barnsley.—A L.G.B. inquiry was held on November 22nd into the Corporation's application for a loan of £3,000 for E.L. purposes, the sum being made up as follows:—Meters, £850; services, £1,100; mains, £1,050. There was no opposition.

Barnstaple.—The T.C. has decided that, from January 1st, all private consumers shall be allowed discount on the year's accounts of 5 per cent. on amounts between £2 and £5; above £5, and not exceeding £20, 7½ per cent.; exceeding £10 and up to £50, 10 per cent., and above £50, 12½ per cent.

Barton. — The R.D.C. recently intimated that it would not transfer its powers under its prov. order, but would endeavour to make satisfactory terms with an existing E.L. company to lease its powers of supply.

Flixton Parish Council met on Monday night last to protest against the action of the Barton authority, whose contemplated order would extend over the Flixton area. The objection of Flixton is based on a supposition that when the Manchester Corporation exercises its running powers to Urmston it will desire to continue the tramway system into Flixton, across the new County bridge over the river, and on to Ashton-on-Mersey. In view of this, the use of the Flixton roads, it is thought, becomes a valuable asset, which the Corporation would be willing to pay for. The Flixton Council has, therefore, asked Barton to exclude Flixton from the scheme until the feeling of the residents has been ascertained. Failing this, notice of opposition will be given.

Birmingham.—The Electric Supply Committee has prepared a report in which it asks the sanction of the City Council to reductions in the scale of charges. When the new generating station in Summer Lane is complete, it proposes to lower the price for lighting purposes from 6d. and 4d. per unit to 5d. and 3½d., and for power the present charges of 3d., 2d., and 1½d. per unit are to be reduced to 2d. 1½d. and 1¼d.

Boston.—The B. of T. has asked the T.C. whether it is the intention of the Council to carry out the E.L. order, 1902, the time extension of which has nearly expired. As a company has asked the Council to assent to their application for E.L. powers, the Corporation has deferred replying to the B. of T. for a fortnight.

Bridgwater.—The T.C. has resolved that in view of the preparation of a new contract with the Bridgwater Gas Light Co., the Bridgwater Electric Supply and Traction Co. shall be asked to submit estimates for the carrying out of the public lighting of the town for the ensuing three years.

Canada.—St. John, N.B.—The electric light works on the west side of the Harbour, by which that section of the city is lighted, were purchased recently from the Carleton Electric Light Co., by Mr. John Russell, manager of the *Telegraph* and *Times* newspapers. The price paid is between $12,000 and $15,000. He will continue to operate the plant as at present until his plans are completed.

China.—Macao.—The Electric Co. is progressing with the erection of the power house, which is now almost completed; the poles in the streets are nearly all fixed. It is proposed to light the streets by incandescent lamps, and the Avenida and the Public Garden by arc lamps.

Continental Notes.—Paris.—A report regarding the electric lighting and power situation in Vienna and Berlin was presented to the Municipal Council on the 27th ult. The most interesting point concerning the situation at Vienna is in the opinion of the delegates (who had recently returned from a Continental tour on behalf of the Municipal Council) the co-existence with three private companies of a municipal *régime*. The report states that the concessions preceded the municipal attempt, which, however, is not to be considered as an experiment on the part of the municipality, but is due to the normal application of electricity to municipal enterprises already existing, such as the gas and tramway undertakings. This system is already well known in southern Germany, and in Vienna it is not in any way akin to the movement for general municipalisation of public services. As to Berlin, the report goes on to state that the prices of energy are low as compared with other centres in Europe, especially when compared to Paris.

The Prefect of the Seine Department has addressed the Municipal Council, expressing his personal views regarding the future policy of the city in respect to the lighting. The concessions of the electrical companies will soon fall in, within a short time of each other. The possibility of municipal enterprise in this direction is likely to be discussed. Since their return from London the councillors have been rather enthusiastic on the subject. The Prefect, however, states that the definite solution of the question of renewing the concessions of the six Sectors now in operation, should be postponed for a few years, and in the meantime a temporary arrangement should be made to cover the transition. He advocates arrangements with the existing Sectors, perhaps by some compensating medium, to reduce the price of energy within the city (which at present is dearer in Paris than in any large city), and propositions to this effect to the several concession holders have been made. Three only out of the six companies replied, and these operate over less than half of Paris. In the circumstances, the Prefect has decided to consider the various applications which have been made to assure the electrical service during the transitory period, and of four propositions, he has selected those of Messrs. Schneider & Co. and Mildé & Co. These companies form part of a new society recently constituted to study the electrical situation in Paris with the view of future concessions. If the Council does not accept his views, the Prefect will consider further propositions, based on the present projects as a minimum.

Brussels.—The *Daily Chronicle's* correspondent states that during the storm last Sunday, the new municipal electricity works, which were approaching completion, were wrecked. Eleven steel columns supporting the iron roof were deflected by the force of the wind, and the roof itself, 282 ft. by 80 ft., was carried a distance of 16 yards. The machinery was badly damaged, and the loss is estimated at £12,000.

Italy.—An electricity works of a capacity of 720 H.P. has been erected near Pordenone for lighting and power purposes in the district. Another station with two alternators of 200 H.P., generating at 7,000 volts, has been installed on the River Arsiero, near Arsiero, by Messrs. P. Zanini & Co., of Asiago.

The Municipality of Gioia del Colle (Bari) has decided upon the installation of electric lighting for public and private use.

The prefectural authorities of Cureo have granted a concession to erect a hydro-electric plant on the River Roia for generating electrical energy for lighting and power purposes.

The town of Amalfi is to be lighted by electricity.

The Societa Elettrica del Ticino intends to carry out projects for generating and distributing electrical energy in Vigenano and Mortara.

Sicily.—A new company, the Societa Giovanni Lacava et Figli and Co., with a capital of 600,000 francs, has been formed at Palermo to undertake electric power supply in the island.

Germany.—A municipal electric light undertaking is to be put down at Ludenscheid.

Coventry.—The E.L. Committee has decided to recommend the Council to apply to the L.G.B. for sanction to borrow £5,000 for the purchase of electric motors, to be let out on hire.

Dundee.—Owing to the increased demand for electricity, Mr. H. Richardson, the burgh electrical engineer, has prepared a report on the subject of extensions to the present plant, and also one on the question of erecting another station to supply H.T. energy to be distributed through sub-stations. To extend both plant and mains in conformity with the existing system, he estimates the cost at £35,000. The alternative scheme, which Mr. Richardson says would be able to cope with a supply on a big scale with some possibilities of commercial success, would cost, with two sub-stations, £75,000, exclusive of land. The matter has been adjourned by the Electricity Committee meanwhile. Further details are to be obtained of the two schemes.

East Ham.—On Tuesday, the Electric Lighting Committee reported the receipt of a letter from the Woolwich B.C with respect to East Ham supplying it with electricity in bulk. The Committee has deferred the consideration of the matter pending the receipt of further particulars. The engineer and manager submitted an estimate for cable extensions and work in connection with the department, amounting in the aggregate to £20,000. This was approved, and the question of raising the amount was referred to the Finance Committee. In connection with the sewage works in hand, the engineer reported that he contemplated the electrification of the whole of the pumping plant, utilising for this purpose the engine and generator recently superseded at the electric station and now lying idle. The electrical energy required for working the centrifugal pumping plant would be generated from the destructor. It might be advisable to connect the generating station in Nelson Street with the pumping station as a reserve in time of exceptional storm or possible breakdown, but this might be done at any time. The advantages of the electrification of such a plant are:—(1) Its power of immediate application in times of sudden storm; (2) economy of management and maintenance; (3) its ease of distribution throughout the works, including also power for workshops; (4) the utilisation of the Council's superseded plant now stored at the generating station. Directions were accordingly given for a specification to be prepared and tenders invited for the supply and equipment complete of the storm pumping plant and other requisite machinery (*a*) by electric power and (*b*)

alternatively by steam power. The existing pumping engines will be retained and will be adapted for electric as well as for steam power in the event of electric pumping being adopted.

Fenton.—The U.D.C. has been asked by the Stoke-on-Trent T.C. to receive a deputation on the question of a prov. order being applied for, to enable Stoke to supply the Fenton district with electricity. The assent of the U.D.C. to receive a deputation has been given.

Holyhead Electric Lighting.—A L.G.B. inquiry was held recently relative to the Council's application for sanction to borrow a further sum of £3,000 towards E.L. extension.

Hosforth.—The Yorkshire Electric Power Co. has agreed to take over the Council's order, and to pay its original cost, on condition that the Council purchase energy for street lighting purposes. The company has offered to light and maintain 80 lamps in the principal thoroughfares at a cost of £2 5s. per 75-C.P. lamp per annum. At the present time each gas lamp, burning 2,200 hours per annum, costs £1 15s.; the electric lamps will burn 3,000 hours per annum, and are, therefore, cheaper than the gas lamps, apart from the greatly increased candle-power that they will give.

Ilford.—The Committee has recommended that the following terms be offered to the Woodford Council for a supply in bulk: "£10 per KW. of maximum demand per annum, with a minimum of 60 KW., plus 1·5d. per unit, with a minimum of 50,000 units per annum." These charges are to be subject to revision at the end of three years. The above terms are on the basis of a 15 years' agreement.

Liversedge.—With regard to the recent decision of the U.D.C. to apply for a loan of £1,500 for an E.L. scheme, the matter has been blocked by a member giving notice of a motion to rescind the resolution. The Yorkshire Electric Power Co., from whom the Council proposes to take energy, have undertaken from the end of the first two years to guarantee the Council against loss; until the end of the first seven years, the average price payable by the Council for units used shall be as follows:—If 50 per cent. is used for motive power, 2½d. per unit; if 67½ per cent., 1⅞d.; if 75 per cent., 1·55d.; if 87 per cent., 1·45d. These terms, it was urged, practically guaranteed the Council against any loss. A petition, signed by ratepayers representing a total rateable value of over £7,300, has been presented to the Council disapproving of the proposed E.L. scheme, which, it is urged, would be a yearly burden to the ratepayers.

Llangollen.—The U.D.C. has sealed an agreement with the local electric light company for a supply of electricity in the district.

London.—HAMMERSMITH.—The Electricity Committee of the B.C. reported on Tuesday having received a communication from the Notting Hill Electric Lighting Co., enclosing an outline of a Bill for promotion next session, which is being prepared under the instructions of the joint boards of the Kensington and Knightsbridge Electric Lighting Co., and the Notting Hill Electric Lighting Co. The main object of the proposed Bill would be an association of the existing companies and local authorities now holding statutory powers under the E.L. Acts in West London, including Hampstead, St. Pancras, Hammersmith and Fulham, and the Bill would authorise the associated companies and local authorities to interchange bulk supply, and to supply energy within the area of each of the associated companies, but only with the assent of the company or local authority in possession of the area in question. The company desired to know whether the Council was willing to join in promoting the Bill, and whether there were any provisions which it might require to be inserted in connection with the area of supply. The Committee decided that it would not be advisable to join in the promotion of the proposed Bill.

L.C.C.—At the meeting on Tuesday it was decided to lend £5,942 to the Southwark B.C. for engineering works, mains and machinery. The Finance Committee recommended the Council to advance £10,891 to Battersea for the extension of mains. Mr. E. Collins opposed the proposal, and referred to the prospective introduction of bulk supply at ½d. per unit. It was stated that, whether private enterprise or the County Council afforded a bulk supply, it would be necessary for the B.C. to have the mains, and the recommendation was agreed to.

POPLAR.—The Electricity Committee has granted an application from the Public Health Committee for a site at the generating station for the erection of plant for the manufacture of disinfectants by electrolysis.

Proceedings taken by a man named Sweeney to recover £50 damages in respect of personal injuries, stated to have been caused through an explosion at a street box, have resulted in judgement being entered for the Council with costs.

Middlesbrough.—The town clerk reports the receipt of an application from the Cleveland and South Durham Electric Power Supply Co. for permission to supply energy within the borough. The company states that it has received promises from Sir Raylton Dixon & Co., Messrs. Richardsons, Westgarth & Co., and the Grand Opera House Co. to take a supply of probably one million units per annum, at prices ranging from ¾d. to 1¼d. per unit. The matter has been referred to the E.L. Committee.

Nantyglo and Blaina.—The U.D.C. has decided to apply to the South Wales Electrical Power Distribution Co. for terms on which it would supply the Council with electrical energy. A joint conference was proposed by the Brynmawr Council with the above U.D.C. to consider the question of public lighting by electricity. The Nantyglo Council has informed Brynmawr of the steps it has decided to take.

Perth.—Mr. Lambert has recommended that the custom of charging accumulators at the Electricity Works be discontinued; to continue the practice would require extra plant. The recommendation has been adopted.

Radcliffe.—It has been intimated to the U.D.C. that the new aluminium works, of which mention was made last week, are not, after all, to be located at Radcliffe. It appears that the Council had passed plans for the intended buildings. The announcement has caused much local disappointment.

Salford.—Mr. C. D. Taite, borough electrical engineer, has sent a letter to the users of electricity in the borough calling attention to the fact that from January 1st, 1906, consumers of electricity for power purposes will be allowed to use energy for lighting purposes at the power rate up to 15 per cent. per quarter of their power consumption.

Seaham.—The Seaham, Murton and Hetton Tramways Syndicate intends to apply to the B. of T. for a prov. order to distribute electricity for power and lighting purposes within the district. The syndicate has also applied for powers to construct a light railway from Seaham Harbour to Murton and South Hetton, to join the Sunderland District tramways at the latter place.

Sheffield.—Mr. Fedden, general manager and engineer to the electricity supply department, has issued an illustrated pamphlet on electrical energy for heating and cooking, from which we learn that, commencing with the new year, the price will be reduced for these purposes to 1d. per unit.

Stirling.—The T.C. has resolved to borrow a further sum of £2,000 for the E.L. undertaking.

Stourbridge.—The E.L. question which has been before the U.D.C. for several years is still unsettled. The Electric Power Committee, after considerable negotiation, decided to recommend the Council to enter into an agreement with a company for a supply of energy in bulk, but the Council, by 14 votes to 13, has referred the matter back for the Committee to submit a scheme with estimates of the cost, "to enable the Council to judge of the responsibilities of the ratepayers."

Sunderland.—The R.D.C. has decided to oppose the application of the U.K. Tramway, Light Railway, and Electrical Syndicate for a year's prolongation of the term of their prov order.

Tiverton.—The National Provincial Electricity Supply Corporation has determined to apply for a repeal of the Tiverton E.L. Order, and for powers to supply electricity. According to a Devon paper, a large section of the ratepayers is distinctly averse to the T.C.'s opposing the application. The price of municipal gas is 4s. 1d. per 1,000 cb. ft.

Torquay.—The National Electric Construction Co., Ltd. has, says the *Torquay Times*, submitted two offers to the Corporation, the first to purchase the electrical undertaking, and the second to lease it for a number of years on a profit-sharing basis, the company paying all interest and redemption charges. These offers have been considered by the E.L. Committee, and the majority of the Committee were certainly impressed with the offer to purchase. The company, we gather, is willing to buy the undertaking at cost price, and, in addition, agrees to make a reduction in the price of energy to consumers.

Walthamstow.—Application is to be made to the L.G.B. for sanction to borrow £10,000 for E.L. extensions. The Woodford U.D.C. is to be informed that the Council is willing to submit a scheme for the supply of electricity to Woodford provided the latter agrees to pay the consulting engineer's fee of 25 guineas.

West Ham.—On Tuesday last the town clerk brought up a lengthy report on the various schemes now on foot for a bulk supply. He states that the Corporation's existing station is capable of generating sufficient energy to meet all demands that are likely to be made upon it, and that, if necessary, there is ample room in the present buildings for the extension of the plant, and furthermore, that there is ground sufficient to enable the buildings to be further enlarged if it become desirable. Mr. Mérz's scheme is dealt with, as are also the local authorities' and the L.C.C. schemes. The Council agreed to a resolution, to the effect that it was undesirable at present to identify itself with any of the proposed undertakings, but that it should retain freedom to take such steps as the Council considered in the best interests of the borough when the various Parliamentary proposals are completely formulated.

Worcester.—The Corporation Electricity Committee has offered to supply energy to the Water and Sewerage Committee for the pumping plant at ¾d. per unit. Two motors, of from 35 to 45 H.P., are to be installed to replace an 80-H.P. gas engine. The capital outlay, with cables, will be £1,120.

TRAMWAY AND RAILWAY NOTES.

Belfast.—On Tuesday the new electrical tramway system was inspected by Major Pringle, R.E., and Mr. A. P. Trotter, Board of Trade representatives. These gentlemen and the Corporation representatives journeyed over the portions of the system to be opened this week, with satisfactory results.

On Wednesday last the first sections of the electric tramway system were formally opened. Six special cars carried the Lord Mayor and members of the Corporation and their friends, representatives of the contractors, Messrs. J. G. White & Co., and others. The sections run over were Malone Road, Ormean Road and Lisburn Road, and the speed varied from 8 to 15 miles an hour. Everything passed off without a hitch, and the public service was begun on the following day.

The trouble about the engines seems to be simply this: In order to run the full service of 174 cars, two of the three generating sets will have to run at full load, the third standing by. The makers of the engines object to the latter being run at full load non-condensing, suggesting three-quarter load as the safe value, and as this would necessitate running the three engines on the normal load, there would be no stand-by. Hence the manager, Mr. Nance, states that he can only recommend that one section of the tramways be run, until the whole of the condensing plant is ready—perhaps in February next.

This seems to us quite excessive precaution. Surely it is far better to run all the cars and chance a possible stoppage, than to run none at all except on one section! A breakdown lasting a day or two could not be worse for the town than the complete absence of cars for 60 days. It is difficult, too, to see why the engine builders are afraid of full load non-condensing. Under such conditions the working is, of course, uneconomical, but unless the initial steam pressure is raised, the strains on the engine are *less* when running non-condensing than when condensing.

Canterbury-Herne Bay.—The Canterbury and Herne Bay Light Railway Co. are applying to the Commissioners for an extension of the period allowed for carrying out the works included in the order.

Cheadle.—The promoters of the Cheshire tramways have decided not to proceed with the line between Cheadle, Handforth, Wilmslow, and Cheadle Hulme.

Dewsbury.—The electric tramway between Dewsbury and Birkensbaw was inspected by Major Druitt, of the B. of T., on Thursday last week, and this week the public through service was inaugurated. Between Dewsbury and Batley the speed is limited to 12 miles an hour, but elsewhere it is 16. From Dewsbury to Birstall the line is double, the rest being single; the total length is about 4 miles. The line as far as Gomersal had been worked with steam previously. Messrs. Dick, Kerr & Co. were the contractors for the reconstruction of the line. Energy for working the new line is taken from the various local authorities. Before long Morley and Ossett will be linked up, and at the latter place communication with Wakefield will be established.

East Ham.—The T.C. on Tuesday decided to proceed with the duplication of the tramways in Manor Park, at an estimated cost of £5,000.

Glasgow.—The Tramways Committee of the T.C. has recommended that the extension from Paisley Road to Govanhill, authorised by Parliament this year, be proceeded with during the present winter, and that the work be executed by the department.

Hastings.—The motor-omnibus service is to be discontinued, owing to the competition of the electric tramways. Arrangements are being made to sell the stock of 11 'buses for £7,000, for use in London. Motor-'bus enthusiasts will find material for meditation in this announcement.

Hythe.—Two schemes for constructing electric tramways from Hythe through Sandgate to Folkestone have been before the T.C. recently—one promoted by the National Electric Construction Co., and the other by the Folkestone, Sandgate and Hythe Tramways Co.

Lincoln.—The service of electric tramcars, on the G.B. surface contact system, was inaugurated on Thursday last week, after the official inspection of the B. of T. had taken place. Mr. S. Clegg, electrical engineer to the Corporation, drove the first car. Subsequently the inventors, Messrs. Griffiths and Bedell, received the members of the Corporation at the Saracen's Head Hotel, and accepted their congratulations on the successful start of the undertaking.

Liverpool.—On Monday afternoon, as an electric car was turning from Church Street into Parker Street, one of the busiest corners in the centre of the city, the trolley-head became detached, and was projected through the large plate-glass front of a florist's shop.

London.—Metropolitan District and Metropolitan Railways.—From to-day important reduction in fares come into force on the Inner Circle. Between Earl's Court and High Street and the intermediate stations to Aldgate East, the single journey fares will in no case exceed 4d. first, and 2d. third-class, instead of 6d. and 3d. as at present; the fares on the north side of the Circle are similarly reduced to 3d. first and 2d. third-class at most.

L.C.C.—The adjourned report of the Highways Committee, which was postponed on several occasions to allow of the Finance Committee dealing with the financial side of the proposed expenditure of £803,000 for the reconstruction of certain of the northern tramways, was withdrawn without any reason being given. The expenditure amounted to £112,000 for the erection of car-sheds and sub-stations; £415,600 for road work and plate-laying; £250,000 for cars, cables, sub-station machinery and switchboards, and £26,000 for alteration to bridges.

The Highways Committee asked the Council to enter into an amended agreement with the London Electric Supply Corporation to supply for three years power to the Greenwich station, where it would be measured, with a minimum of 1,500,000 units a year, at a price for the first 2,000,000 units of 1d. per unit, and for any quantity beyond that amount at ·75d. per unit. The agreement was subject to the company holding sufficient plant at the disposal of the Council to allow of a maximum demand of 1,500 KW., and purchasing the plant installed by the Council at the Deptford station for the sum of £13,000. In the course of a report on the subject the Highways Committee stated:—"The price paid to the company under the present arrangement is 1·65d. per unit, and the Council undertakes to take a minimum of 2,500,000 units a year. Arrangements should be made for the company to continue to supply current to the Council, not direct to the tramways, but to transmit it to the Greenwich generating station. When the Greenwich station is completed, it cannot immediately undertake the whole of the necessary supply for the existing tramways, as this must be done gradually. In addition, we have had under consideration the question of the early construction of about 10½ miles (single track) of the Council's (Northern) tramways other than the first section (equivalent to about 22½ miles single track) which is to be reconstructed. Should it not be found possible, however, for financial or other reasons to undertake this work in the near future, the Council would not be bound to take from the company any supply which it could not use, the minimum prescribed being 1,500,000 units, and this amount of energy could be consumed annually in working the present night car services or light mid-day or Sunday services on the Council's tramways, when it would not be economical to keep working the large generating sets at the Greenwich generating station. The price at which the company is prepared to supply is sufficiently reasonable to enable this economy to be effected. The proposed new arrangement will supersede the present arrangement, and will, it is suggested, come into operation about April 1st, 1906."

Macclesfield.—Parliament is to be asked next session for powers to construct tramways, to be worked by electricity, along certain thoroughfares in Macclesfield, and also from that town to Hazel Grove. Two unsuccessful attempts have already been made to get a Bill through Parliament embodying these powers. Opposition is now threatened by ratepayers of Macclesfield. Another scheme, in which the town is deeply interested, is the construction of a line of tramways from Macclesfield to Knutsford, *vid* Chelford. This would be an enormous convenience to large numbers of people living in an area ill-provided with railway accommodation. In addition, it would command a very large holiday patronage in summer.

Middlesex.—The award of the arbitrator in the dispute between the County Council and Messrs. William Griffiths & Co., Ltd., the contractors for the Lordship Lane and Bruce Grove tramway, was made known at the meeting of the County Council last week. The arbitrator held that the County Council was not entitled to any penalties, and that Messrs. William Griffiths & Co. were not entitled to any damages; that each party should pay the other party's costs, and that the costs of the award should be equally divided between the two parties.

A Bill is to be promoted in the next session to authorise the construction by the Council of a tramway from the terminus in Edgware Road to Kilburn, near Bridge Street.

The proposed tramway to Sudbury is to be continued along the Harrow Road to the Webley-Harrow parish boundary.

Application is to be made to the Light Railway Commissioners for an order authorising the construction of a line 7 furlongs 5 chains in length, linking the lines terminating at the junction of the Watford Road and the Edgware Road and the line from Watford to Bushey Heath.

Ramsgate.—The report of Lieut.-Col. von Donop on the accident which occurred on August 3rd on the Isle of Thanet Light Railways has been issued. It states that the accident arose through the failure of the driver to stop the car, according to the B. of T. regulations, at the top of Madeira Hill. The car went over the brow of the hill at too high a speed in consequence of this, and got out of control. The conductor noticed the failure to stop, and the high speed, and put on the slipper brake, while the driver must have applied the hand brake, as the wheels were skidding. The driver was apparently regaining control of the car, when it took a reverse curve, and at the point of reversal it was derailed, thanks to the high speed and the sharp curvature. The car ran across the road and over the edge of the cliff, but fortunately no one was killed. The gradients were not excessive, varying from 1 in 13 to 1 in 16; the regulation speed in descending the hill is 3 miles per hour. The chief blame is laid upon the driver for not conforming to the regulations, but the company is also censured for allowing a driver of only nine days' standing to drive cars on this route. Some minor alterations in the track and brakes are recommended.

Walthamstow.—A conference is to take place between representatives of the U.D.C. and the Leyton U.D.C. with reference to running powers over the tramway system of the latter authority.

(*Continued on page* 893.)

A NEW PROCESS OF WIRE COVERING.

It is not often in these prosaic days of well-established processes that we have brought to our notice such a radical departure from present methods as the new process for the cotton and silk covering of wires, invented and perfected by Messrs. W. A. Phillips & F. Hutchins, of Crescent Works, Harlesden, promises to be. The process and the special machinery adopted for carrying it out are the outcome of over five years' experimental work on the part of the inventors, whom we should not be treating justly did we not offer them our sincere congratulations on having brought within practical reach an economic invention of great prospective value.

Considering the smaller grades of covered wire, for instance, as our readers are aware, it is usual to apply a spiral winding of yarn, which, critically examined, reveals a corrugated covering, with intervening spaces between the insulating strands; now, by the new process, the inventors have sought and succeeded in applying a homogeneous felt-like covering to the wire, of a thickness which obviously can, with equal efficiency, be much less than with yarn or thread.

For cotton covering the material used is unspun roving, which is first passed through and attenuated by drawing rollers: these feed the fibres of cotton into a device, which incorporates a rapidly revolving hollow spindle of special construction, through which the wire is fed. The spindle rotates inside a fixed casing connected to an exhausting fan. The combined result of the rotation of the spindle and the air suction is to create an air vortex over the head of the spindle, and the latter, as it rotates, draws out and spins the cotton fibres around the wire as it passes down through the head of the spindle.

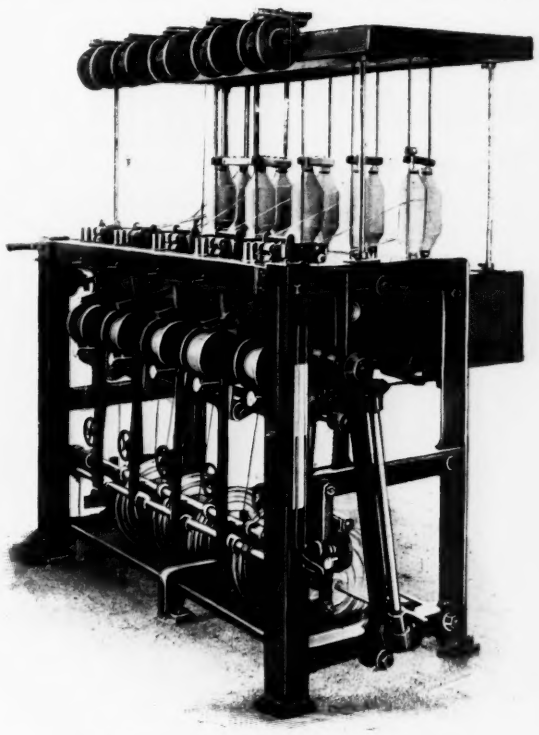


Fig. 1.—End View; Wire-covering Machine.

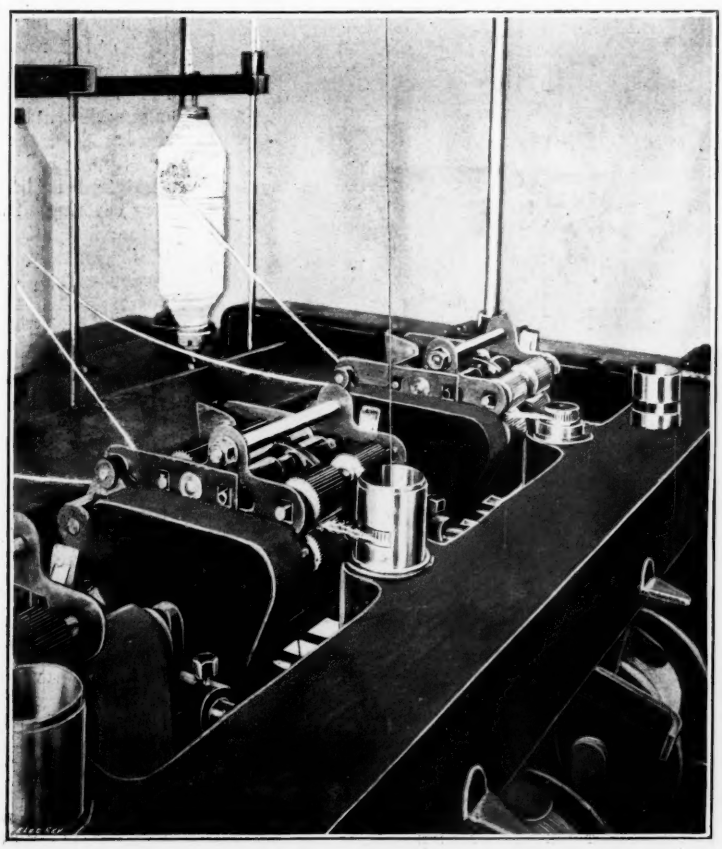


Fig. 2.—View of Feed Rollers and Covering Device, showing Roving Feeding on to the Latter.

Figs. 1 and 4 illustrate a completed machine adapted for single covering, and fig. 3 is a transparent drawing of the "covering device," on the operation of which the process depends.

The accompanying diagram, fig. 5, shows the essential elements of the new machine: *a* is the cotton roving passing through three pairs of drawing rollers, of which the front pair run at 10 times the speed of the back pair, thus attenuating the cotton. The hollow spindle, *b*, through which the wire, *c*, passes, is driven by pulley *d*, and has a hollow perforated head, *e*, the top of which is covered with wire gauze, having an eyelet in the centre. The spindle, the total weight of which is under 2 ounces, runs at a speed of over 30,000 r.p.m. in a white-metal bearing *f*, so arranged that there is a continuous circulation of oil, the lubrication being assisted by a spiral groove on the spindle. The hollow framework of the machine, *g*, is connected to an exhausting fan. The top of the rotating spindle is covered in by a fixed case, *h*, provided with a slot *k*, through which the cotton is sucked. The intense vortex created inside the case, *h*, by the air suction, in conjunction with the rota-

tion of the spindle, causes the fibres of cotton to be attracted to the centre of the bronze gauze top of the spindle at *n*, where they are whirled round the wire, being afterwards firmly compacted on to it by a spring inside the slotted head, *e*.

The spindle, with its white-metal bearing, stands in an oil bath (seen in figs. 3 and 5), with which it is in direct communication by means of small oil holes in the bearing; the spindle throughout its length is constructed to a slight taper, and the latter together with the spiral oil groove ensures, at the high rotative speed in use, that the oil shall creep up to the head of the spindle. As it is of the utmost importance that the oil shall not creep up to the covering material above, a specially shaped petticoat flange is formed round the head of the bearing, which throws the oil down again, allowing it to drain through into the reservoir below.

Perfect lubrication is, of course, essential at such high speeds, and it is of interest to note that electrical tests have proved the existence of an oil film on the spindle, the rotation of which is perfectly cool owing to the air suction which takes place in its vicinity.

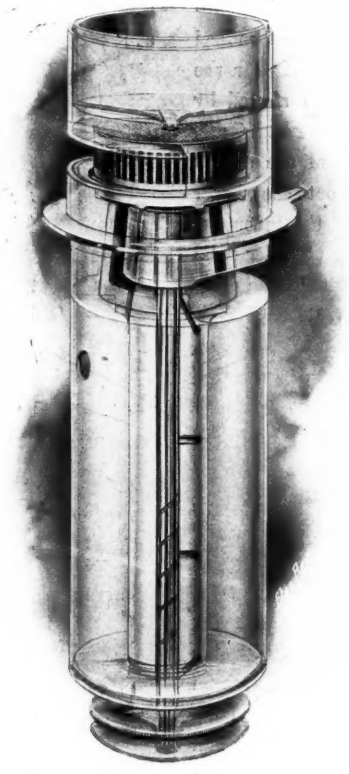


Fig. 3.—Transparent View of Covering Device.

The action of the rotating head in drawing out the fibres will be better comprehended when it is remembered that a slight air suction occurs through the perforations on the side of the rapidly rotating head, thus causing some adherence of the individual fibres to the latter, which pulls them out singly, but at a great rate; the fibres are afterwards drawn over the top of the head and whirled towards the centre (round the wire) the air suction being naturally greatest at this point, owing to the relatively lower speed of rotation there.

It may be mentioned that a ledge is provided over the entrance slot in the outer casing to prevent the direct entrance of the roving; and that an ingeniously placed paper washer which surrounds the head below the perforations, suffices for an air seal to the casing of the machine, this action being assisted by the fine particles of cotton which are drawn into the gap.

The machine insulates the wire at the extraordinarily high rate of 85 ft. per minute, and even this speed has been exceeded. The insulation consists of a hard felted covering, which is highly suitable for taking varnish. It is claimed for the new process (1) that a thin insulation can be made, using cotton, which costs no more than that used for a thick covering, and the cost of roving is obviously less than that of yarn, especially in the fine counts. In the case of silk, the material used is that known as "waste" instead of "floss" silk. (2) The speed of production is ten times that of the ordinary process; (3) the machine is easy to manipulate, and requires very little training, as compared with the ordinary methods; (4) the thickness of insulation can be varied with great exactness, to give a specified diameter; (5) there are absolutely no knots or visible joints of any kind in the covering, a point specially important in the case of fine wires; (6) the length of wire that can be insulated in one piece without a stop is unlimited so far as the action of the machine is concerned, as the cotton roving is pieced up without stopping—in fact, by simply leading a fresh end of roving into the feed rollers, the action being automatic afterwards.

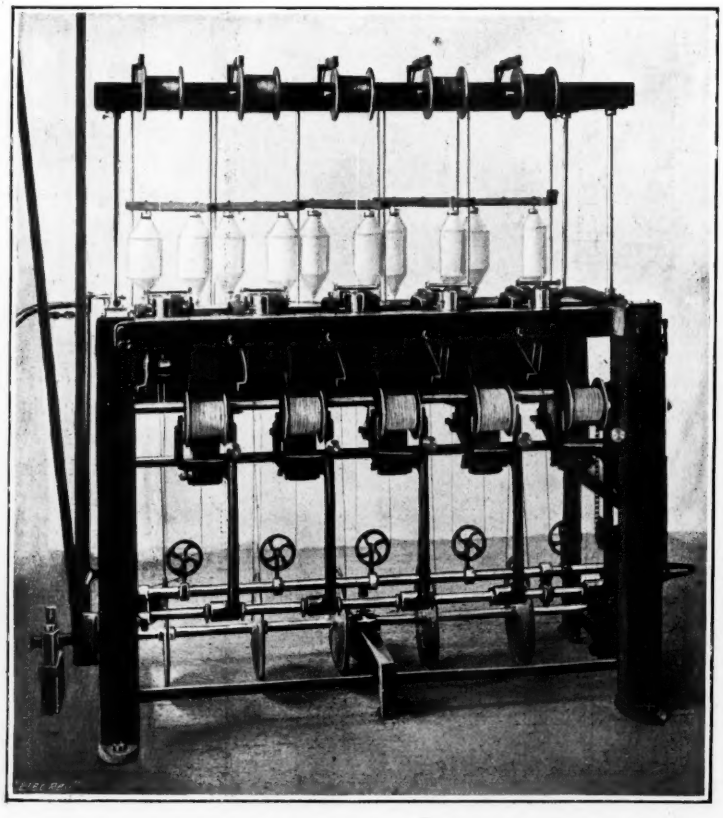


Fig. 4.—Front View of Machine.

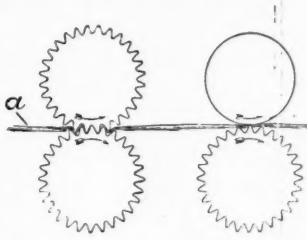
The machine illustrated is built for covering five wires; its construction generally is obvious from our views. The five covering devices can be seen on the front frame of the machine, which serves as the exhausting trunk, and in common with others is connected to an exhausting fan, the negative air pressure maintained being about 8 in. of water.

The lower shaft of the machine revolves at some 2,500 r.p.m., and the five pressed aluminium pulleys mounted on it transmit motion to the rotating spindles of the covering devices.

The feed handles, seen projecting below the wire bobbins in the front of the machine, are for tightening up the

belts which simultaneously actuate the feed rollers (for the covering material) and the wire bobbins. The handles when pushed in to start the feed are held in position by small electro-magnets fixed behind the machine.

These magnets are energised through a circuit which includes the wire to be covered; and in the event of the latter breaking, or of the covering material feeding irregularly and leaving bare patches of wire below the covering device, and so earthing the circuit on to a contact provided for the purpose, the magnets are de-energised, the handles come out (by gravity), and the respective feeds stop.



Great care has necessarily been exercised in perfecting the various details, and the inventors' double covering machine, which is in course of erection, and in which the wire is fed alternately through similar covering devices to that described, but revolving in opposite directions, will be watched with great interest on its completion.

The economic value of a machine which covers 85 ft. of wire a minute, and at the same time uses covering material which represents a saving of from a quarter to three-quarters cost in the case of cotton and of some two-thirds cost in the case of silk, and, further, permits of the finest grade of covering, needs no further mention from us; the inventors are practical men with long experience in the work, and, from our personal observation, their claims in regard to fine wire covering appear to be justified.

THE PEKING ELECTRIC CO.

Before the Boxer rising of 1900, part of Peking was lighted from a small alternating station in the Tartar city, situated close to, but outside, the Legation quarter. Owing to its defenceless position it was completely destroyed during the trouble, so that when the Peking Electric Syndicate projected a new plant, the permission of the Ministers was only given on the understanding that the generating plant should be inside the defence walls of the Legation quarter. When the new scheme was carried out, the light was first switched on on November 6th, 1904, the contractors for the complete plant being Messrs. Arnhold, Karberg & Co., of Tientsin, who now act as general managers.

Owing to the proximity of several Legations to the station, a rather unusual method of building was resorted to. The whole building space was excavated to the depth of 8 ft. 3 in. and 2 ft. of lime and mud concrete were then stamped in, forming a cheap and satisfactory floating foundation. On the top of this were constructed the engine and wall foundations. All the latter, and the walls up to the height of the travelling crane girders, were built in fire brick and cement mortar, as the local bricks are very easily broken and would not have been suitable. The engine foundations are carried up to a height of 4 ft. 2 in. above the ground level; the engine room floor, which is formed of cement concrete, supported by girders, is level with the top of the foundations. The intervening space between the various foundations is used as a basement, in which are placed the balancers, the engine piping and cables, &c.

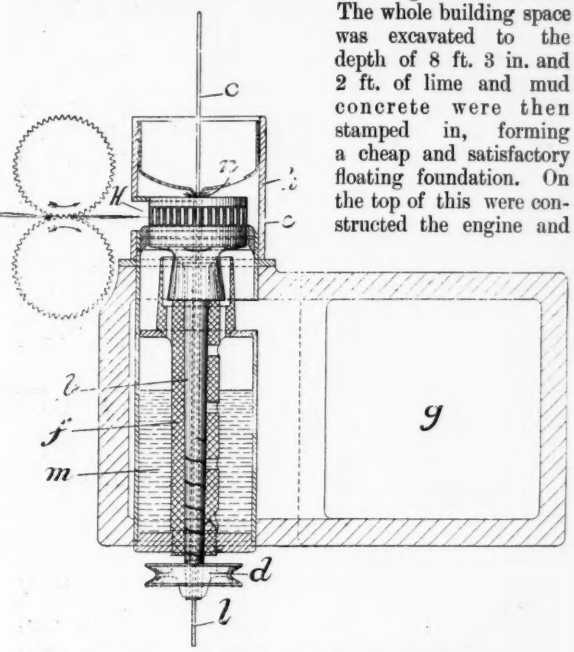
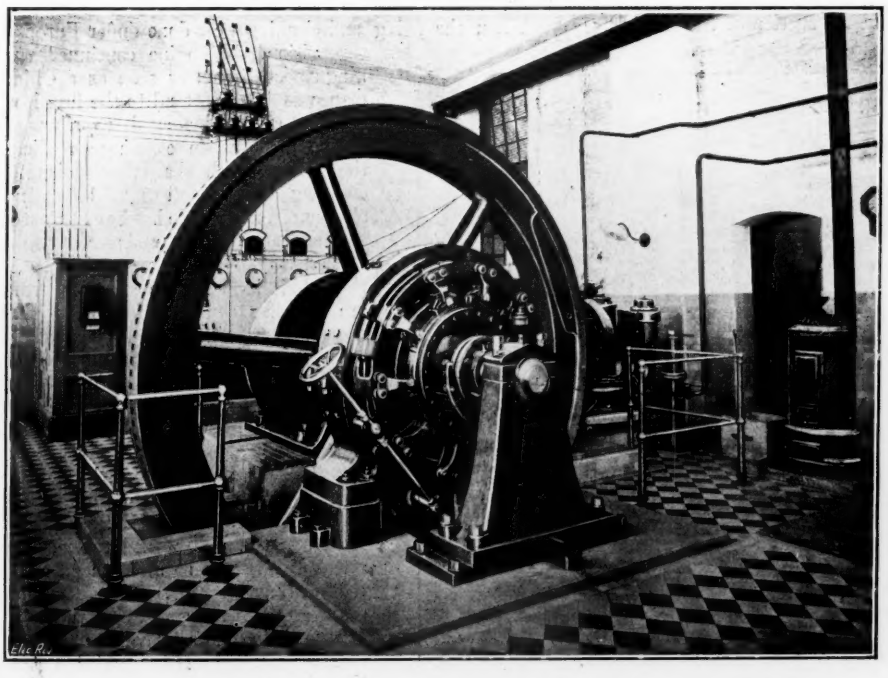


Fig. 5.—Sectional Drawing of Covering Device, &c.



The Peking Electric Co.'s Engine Room, Showing a Gas-Driven Unit.

The building consists of an engine room, gas generator room saw-dust box room, regulator room, accumulator rooms, fuel store, workshop, two office rooms and an engine stores.

The fuel store is interesting from the fact that the entrance for the coal is a window. The coal is brought from the mines to the works by camels; the window sill is at the height of a camel's back. For unloading, the camels pass before the window and the coal bags are lifted off their backs and swung through the window by a small hand crane.

In the engine room are installed two of Korting's gas engines of 80 B.H.P. output, at 140 revs. per minute. These drive direct two continuous current dynamos supplied by the Allgemeine Electricitäts Gesellschaft, of Berlin.

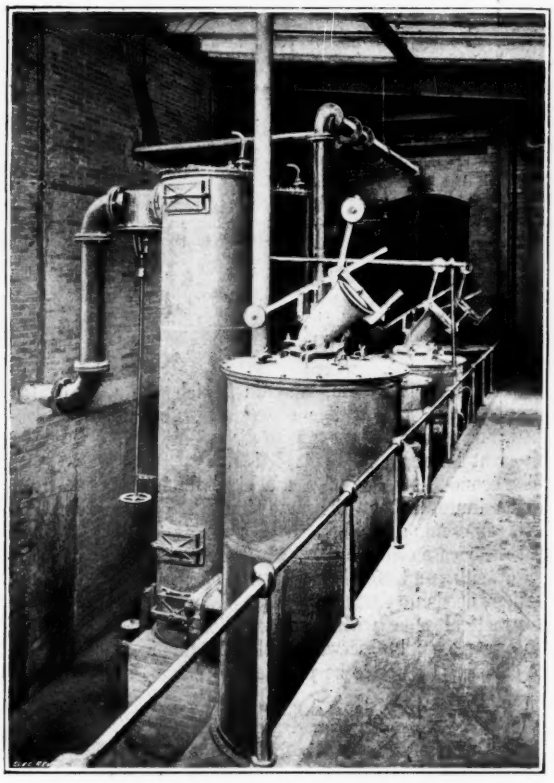
The gas engines are single acting with balanced cranks and are provided with magneto ignition.

The dynamos are constructed for an output of 110 amperes at 440 to 480 volts, with a speed of 140 r.p.m. In addition to the ordinary commutator, the dynamo has two slip rings connected to the armature windings for use with static balancers, which practically consist of an inductive coil across the two slip rings with the neutral wire connected to the middle. Each dynamo has a separate balancer which will take 25 per cent. of the output. The station has now been running for a year and not the least trouble has been experienced with these balancers, which certainly would not have been the case with rotary ones and Chinese attention.

The switchboard consists of two dynamo panels, two battery panels, a booster panel and a feeder panel. Each dynamo has two ammeters, one for the negative and one for the positive main, it being very much easier to balance them thus, as each dynamo is balanced by itself. A battery of 124 cells on each side, manufactured by the Berlin Accumulator Co., is installed in two basement rooms. This is capable of supplying 200 16-c.p. lamps for 10 hours. The regulation of pressure is carried out by means of multiple contact switches at the middle wire end of each half. There is both a charge and discharge arm on the switches, and the charging can be carried out in two ways; either by charging the regulating cells by means of the booster and the remainder of the cells by the main dynamo, or by taking the discharge arms off their contacts, and charging the whole battery across the mains with the booster in series. The second arrangement was carried out in Peking, necessitating a slight modification of the board, but it was found necessary as the charging of the cells was carried out very unevenly with the former method by the Chinese.

The producer house contains three of Messrs. Korting's suction gas generators. The gas is made from coke: anthracite has been tried but has been found difficult to obtain in even qualities, as the mines which are being worked at present are still at their surface seams. When they reach lower levels the coal may be of a better quality, and it may be tried again.

The generators are of ordinary construction, the necessary steam being supplied from an evaporator through which the gases pass after leaving the generator. The gases then pass through a coke scrubber, a saw-dust cleaner and a pressure regulator to the engine. The pressure regulator consists of a hollow cylinder which is pulled against the suction of the engine by means of a spring. When the engine sucks the gas, the cylinder is pulled down against the compression of the spring: when the engine starts compressing and the suction stops, the spring pulls up the cylinder and draws gas from the generators, thus keeping a steady suction on the fires. This arrangement makes a wonderful difference in the steadyness of running. Originally, the station was designed for one generator per engine, but it was found that with the inferior quality of coal obtainable here and the equally inferior workmen, it was necessary to install a third generator.



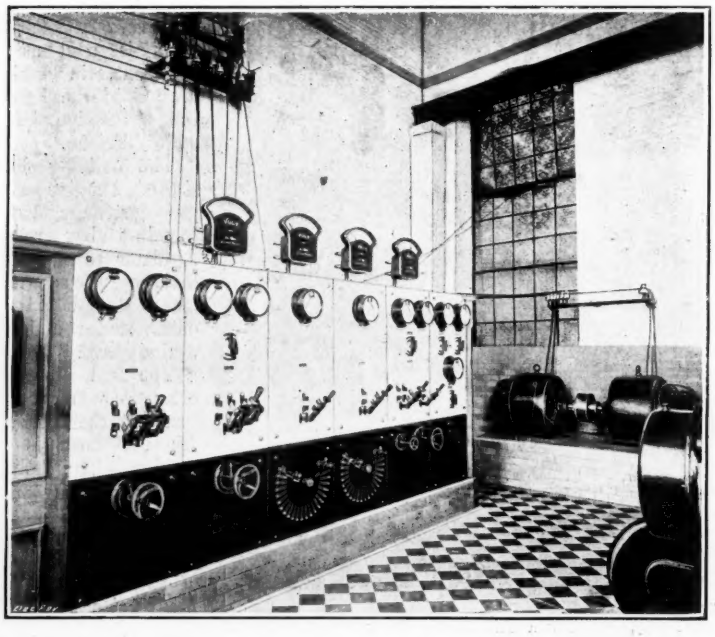
Interior of the Producer House.

When the firing and cleaning were done under European supervision, the engine continued running smoothly, but as soon as a Chinaman was left to attend to the fires himself, he always managed to slow the engine down when cleaning or slicing the fires. With the other generator, enabling the two fires to be cleaned alternately, no trouble has be experienced.

The roof of the producer house is formed by the cooling water tank. In the ashpit level of the generator room are installed the fans for blowing up the fires, one being driven by hand and one by motor. There is also a plunger pump for charging the compressed air reservoir used for starting the engines.

As Peking is remote from all repair shops, it was considered advisable to install a repair shop in the station, specially suited for the work to be expected on the plant installed. The workshop contains work-benches, vices, a lathe with screwing attachment, a vertical drilling machine, grind stone, pipe-screwing machine and forge, the whole of these being motor-driven.

The distribution is carried out on the three-wire system, the overhead cables being of bare copper, carried on lattice poles. There are three feeder points, at which the poles are equipped with copper ring bus-bars, fuses, pilot wire connections and lightning arresters. Since starting the station, the fuses have only been blown once, and then it was by a wind short on the feeder wires. All the buildings are wired on



View of the Switchboard, Showing the Bare Feeders Leading from the Building.

the three-wire system with three-wire meters. The out-of-balance current at the switchboard has never been more than 5 to 8 per cent. At present an equivalent of 5,500 8-c.p. lamps are connected, and extensions to the plant are being taken in hand.

TRAMWAY AND RAILWAY NOTES.

(*Concluded from page* 888.)

Simplon Railway.—According to a Swiss contemporary the question of the introduction of electric traction in the Simplon tunnel is rapidly nearing solution. Arrangements are being made with Messrs. Brown, Boveri & Co., of Baden, for carrying out the work. The system which will be adopted is that of Messrs. Ganz and Co., which has been used for many years on the Valtellina railway. Three-phase alternating currents, with a voltage of 3,000, will, therefore, be employed. The ordinary trains will each be composed of a motor-car and two, three, or four ordinary cars. Heavy trains will be drawn by electric locomotives, two of which are actually being constructed by Messrs. Brown, Boveri & Co. They will be finished by the end of the year, and will be tested over the Italian lines. The electric power will be supplied from Domodossola, a distance of 25 miles. The passenger trains will run at a speed of 40 miles per hour, and the cost is estimated at 1,000,000 fr.

Messrs. Bruce Peebles & Co., who hold the Ganz patents for this country, inform us that the Swiss Government has accepted the proposition of the Italian Government to place five electric locomotives, supplied by Messrs. Ganz & Co. for the Valtellina line, at its disposal for use in the tunnel, which will be opened for public traffic on May 1st, 1906.

West Ham.—A through service by the West Ham and East Ham cars between Canning Town terminus and Barking Town terminus was commenced on the 17th inst. The extensions in Tramway Avenue and The Grove, Stratford, are now open to traffic. The B. of T. has consented to the Corporation placing on the back arm brackets of the poles used for tramway purposes electric wires for the purpose of lighting Hermit Road and Beckton Road.

Wolstanton District Council.—The Potteries Electric Traction Co. has agreed to pay the whole amount of the general district rate now due from it, on the understanding that the Council will repay the proportion of three-fourths on the light railway should the Court decide that the light railways were liable to be rated at one-fourth of the rateable value only.

TELEGRAPH AND TELEPHONE NOTES.

Bahamas.—The Governor in the Annual Colonial Report states, in reference to the telegraph service, that total interruption of telegraphic communication by the cable between Nassau and Jupiter was reported on October 16th, 1904, and continued until December 9th, when the Henley Co. completed the repairs, and communication was restored. Up to the date of complete interruption the cable had been in weak condition from the numerous leaks in the shore ends at Jupiter and at Nassau, which had existed for a year or more, but no delay or errors had occurred in sending or receiving messages. The break which caused the final and complete interruption was finally located 4 miles from the shore at Jupiter, and was caused by the chafing of the cable on the rocky bottom until it parted, no doubt due to abnormal currents during the hurricane of October 16-17th. The cable was repaired at a cost of £4,359. The Superintendent of Telegraphs points out that previously to this break, cable communication had lasted 13 years without interruption or mistakes, and he considers this a very satisfactory record. A total of 3,311 messages passed over the cable, of which 435 were to and from Great Britain, and 2,330 to and from other countries. The revenue was £1,220 7s. 8d., and the expenditure £572 16s. 2d.

Australian Long-Distance Telegraphy.—On Sunday morning, September 24th, 1905, a somewhat remarkable achievement was attained in a trial of long-distance working over the Australian telegraph lines. Mr. Jenvey, electrical engineer for Victoria, had made the suggestion that a trial should be made, and the admirable co-operation of the electrical engineers in the other States of the Federation resulted in Broome, a station on the north coast of Western Australia, being placed in easy communication with Cape York, an office on the extreme northern point of Queensland, over a distance by the route of the line of 6,601¼ miles.

Broome and Cape York passed the time of day and carried on a conversation for 15 minutes at a key speed of 20 words per minute without the least sign of lag in the signals. Broome stated that the temperature was 100° in the shade there, while Cape York set it down at 80 at his end. The signals passed from one terminal station to the other splendidly, and amply demonstrated to the satisfaction of all concerned that through telegraph working from one end of Australia to the other was a practicable feat.

With the attainment of this successful result the terminal stations were taken off, the intermediate circuits were dismantled, and the experiment came to an end.

Sunday morning was chosen for the test, as being the most suitable time. Except for occasional private and a few Press telegrams, those engaged in telegraph work have very little local business other than the receipt and dispatch of shipping intelligence to occupy them on Sunday mornings.

By referring to the accompanying skeleton map of Australia, the course of the circuit can be readily traced. There were 13 repeating stations, numbered in the column 1 to 13, and the various sections of line were made up as follows:—

No.	From	To	Telegraph system.	Class of line wire in use.	Distance in miles.
0	Broome	—	—	—	—
1	Repeater at	Roeburne	—	—	—
2	,,	Geraldton	—	—	—
3	—	Perth	Duplex	400 lb. iron	1,466
4	Perth	Coolgardie	Quad.	200 lb. copper	356
5	Coolgardie	Eucla	,,	,,	563
6	Eucla	Yardea	,,	300 lb. copper	455
7	Yardea	Adelaide	,,	,,	385
8	Adelaide	Melbourne	,,	,,	487
9	Melbourne	Sydney	,,	800 lb. iron	575
10	Sydney	Brisbane	,,	400 lb. copper	179¾
	—	—	,,	300 lb. ,,	318
	—	—	,,	Sub. cable	¼
	—	—	,,	Aerial cable	¼
11	Brisbane	Bowen	Duplex	200 lb. copper	430
	—	—	,,	400 lb. iron	378
12	Bowen	Townsville	,,	,,	127
13	Townsville	Junction Creek	,,	,,	285
14	Junction Ck.	Cape York	,,	,,	602

Grand total, 6,601¼ miles.

Some 10 years ago, viz., on Sunday, May 26th, 1895, a similar trial was made, and on that occasion Derby, a station 124 miles north of Broome, was linked to the circuit. At that period the various State postal departments of Australia were working under different and separate administrations, some using the Universal and others the Australian telegraph code, which fact reduced the key speed to 10 words per minute for that trial. All Australian departments are now subservient to the control of one Central Federal office, and the Universal code has become general since 1897. For some reason not assigned, Derby was not available for the recent test. There is no direct line connecting Derby to Port Darwin, or the latter to Cape York, so that it was not possible to encircle the whole of the Continent by one speaking circuit.

Route of 6,600-mile Telegraph Circuit.

The composite nature of the line and the character of the ground traversed must be considered in estimating the value of this achievement. Some sections pass over desert, forest, and mountainous country and through water, and are exposed to the destructive effects of high winds, storms and rain, as well as damage from passing traffic. In order that a test of the description under review may be successfully carried out, it is necessary that:—

1. The sections of the line must be in good working condition.
2. The repeaters should be well adjusted and carefully watched.
3. Batteries must be well up to their maximum strength.
4. There should be good local management and supervision of the circuits.

So far as is known, actual demonstration over such a lengthy circuit is rare, and it is probable that nothing of the same nature has been accomplished in any other country.

The following were the technical officers principally concerned in the test, viz.:—Messrs. Jenvey and Diercks, at Perth; Mr. Unbehaun, at Adelaide; Messrs. Howard and Fitzgerald, at Melbourne; Mr. Nelson, at Sydney; Mr. Hesketh, at Brisbane; and Mr. Murphy, at Townsville. We are indebted to Mr. T. Howard, assistant electrical engineer, Melbourne, for the foregoing particulars.

Glasgow.—The underground cable connecting London with Glasgow has now been led into the Glasgow General Post Office, and the new service will be working by the middle of December.

Leith.—The National Telephone Co. has opened a new C.B. exchange at Leith, with a capacity of 3,000 subscribers and 100 junctions. It is at present equipped for 1,000 subscribers.

Rangoon.—The Oriental Telephone Co. is about to abolish the overhead wires and put all the circuits underground.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Dominica-Martinique	May 7, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	..
Closed { Port Arthur-Chifu	Mar. 9, 1904	..
Jamaica-Colon	Jan. 5, 1905	..
Cadiz-Tenerif	July 20, 1905	..
Oran-Tangier-Cadiz	Oct. 30, 1905	Nov. 22
Puerto Plata-Martinique	Oct. 30, 1905	..
Bolama-Bissao	Nov. 21, 1905	Nov. 27
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..
Kertch-Soutehoum	Sept. 27, 1904	..
Communication with Brazil *via* Galveston	July 18, 1905	..
Alaska landlines	Nov. 21, 1905	Nov. 23
" "	Nov. 27, 1905	Nov. 28
Rome-Constantinople	Nov. 24, 1905	Nov. 24

Venezuela.—A Reuter's message from Washington declares that President Castro is beginning to show signs of a possible intention to modify his attitude towards France, so far as concerns the diplomatic relations between the two countries. The State Department declares that the United States never approved the language of President Castro's note to M. Taigny, and its withdrawal will be a matter of satisfaction to the United States as well as to France. The *Herald's* Caracas correspondent states that President Castro is now asking France to present the reasons upon which she founded her protest regarding the action of Venezuela against the French Cable Co.

Warsaw.—The chief telegraph office at Piotrkoff has issued an order prohibiting telegraphists from transmitting telegrams to Count Witte or the Central Government containing complaints with regard to the political situation.

Wireless Telegraphy. — Italy. — The Minister of Posts and Telegraphs has nominated a scientific commission to consider the establishment of a wireless telegraph station for internal communication, and for communication between the mainland and the surrounding islands.

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—December 18th and 19th. The Deputy Postmaster-General, Brisbane, invites tenders for the supply of insulators, phosphor bronze wire, copper sleeves, binders and tapes.

The Deputy Postmaster-General, Melbourne, invites tenders for the supply of (1) 10 miles of 26-pair lead-covered paper-insulated telephone cable; (2) 1 mile of 156-pair lead-covered paper-insulated telephone cable (12½ lb. conductors); (3) 5,000 barrel insulators, delivery within three months of date of acceptance of tender.

Austria.—December 20th. The Austrian State Railway authorities at Pilsen are inviting tenders until December 20th, for the establishment of an electric lighting plant at the railway station in that town.

Bermondsey.—December 8th. Water-tube boiler, and 500-kw. steam dynamo for the B.C. See "Official Notices" November 24th.

Bradford.—December 2nd. General stores for the tramways department. Forms of tender and conditions at the Tramway Offices, 15, Bridge Street, Bradford (one guinea).

Brazil.—December 16th. The municipal authorities of Sao Luiz (Maranhao), Brazil, are inviting tenders until December 16th, for the electric lighting of the town.

Nichteroy (Rio de Janeiro).—Installing a system of electric lighting.

Buxton.—December 15th. One 52-kw. gas-driven balancer set for the U.D.C. See "Official Notices" to-day.

Clyde Navigation.—December 18th. Crane, electrically-driven capstans, and tipping turntables. See "Official Notices" November 24th.

Glasgow.—December 4th. 1,000-kw. motor-generators, and high and low tension sub-station switchgear for the Corporation electricity department. See "Official Notices" November 24th.

Ilford.—December 12th. Triple-concentric armoured cable for the U.D.C. See "Official Notices" November 24th.

India.—December 5th. Bombay, Baroda and Central India Railway Co. invite tenders for the supply of the following stores, viz:—Electric generators; switches. Specifications can be obtained at the Offices, Gloucester House, Bishopsgate Street Without, E.C., on payment of 21s. each (not returnable).

Launceston (Tas.).—January 15th. 500 or more electric meters; maximum demand indicators; for the Corporation. See "Official Notices" November 17th.

N E. Railway.—December 2nd. The North-Eastern Railway Co. wants tenders for the supply of arc lamp carbons, electric lamps, wires and cables. The company is also asking for tenders for telegraph stores.

Poplar.—December 13th. Steam engines, dynamos, pipework, switchboard, wiring, motors, fire alarms, telephones and electric bells for the Guardians. See "Official Notices" November 17th.

Southwark.—December 6th. Electric wiring and fittings for the B.C. new stables. Specifications to be seen at Borough Engineer's office, Town Hall, Walworth Road.

Spain.—Tenders have just been invited by the municipal authorities of Jaca (Hulsca province) for the concession for the electric lighting of the town.

Stalybridge Joint Board.—December 18th. Advertising rights on 55 electric cars. See "Official Notices" to-day.

Swindon.—December 19th. Three double-deck radial axle truck tramcars for the Corporation. See "Official Notices" to-day.

Warrington.—December 6th. One 300-kw. turbo-alternator; and one 100-kw. motor-alternator; switchboard transformers and cable for the electricity department. See "Official Notices" November 24th.

CLOSED.

Beckenham.—In connection with the extension of the electric light work, to supply the Penge tramways, the Council has accepted the tenders of Messrs. Babcock & Wilcox, Ltd., for boilers, at £3,375, and for pipe-work, at £1,750. The contract for engines and dynamos has gone to the General Electric Co., and that for the condensers to Messrs. Mirrlees, Watson & Co., while the switchboard is to be supplied by Messrs. Elliott Bros., at £545.

Dartford.—The U.D.C. has accepted the tender of Messrs. Wm. Dickinson & Co., of Bexley Heath, for wiring the carsheds for the E.L., at £116 17s.

The U.D.C. has accepted the tender of the Western Electric Co. for the supply of house service cable.

Fareham.—The B.G. has accepted the tender of Messrs. Tuck & Co., for the installation of the E.L. at the sick wards of the Infirmary.

London.—The following tenders have been received by the L.C.C. Education Committee for the supply of a 30-h.p. motor at the Old Montague Street School, Whitechapel:—

Siemens Bros. & Co.	(accepted)	£99 16
Lancashire Dynamo and Motor Co.		102 0
Veritys, Ltd.		105 10
Electric Construction Co.		111 0
Electromotors, Ltd.		122 14

Westminster.—The Public Libraries Committee has received the following tenders for putting the electric light installation at St. Martin's Lane Library in repair:—

T. Potter & Co., Ltd.	(provisionally accepted)	£73
F. J. Coleby & Co.		74
Lund Bros. & Co.		88
Leo Sunderland & Co.		104
Drake & Gorham, Ltd.		110
Foote & Milne, Ltd.		119

West Ham.—The Corporation received the following tenders for 12 arc lamps:—

Brockie-Pell Arc Lamp, Ltd., £4 18s. 6d. per lamp.
Johnson & Phillips, £5 per lamp, 18s. 6d. for line resistances.
Crompton & Co. (accepted), £4 12s. per lamp, 15s. line resistances.
British Thomson-Houston Co., £5 per lamp, 17s. 6d. line resistances.

The Corporation has accepted the tender of Glenfield & Kennedy for four meters to be fixed on the water-feed ranges at the generating station, at £55 10s. per meter.

Middlesex.—The County Council on Thursday placed an order with Messrs. Dick, Kerr & Co. to construct tramway No. 14 along the Gt. North Road from Whetstone to the Middlesex and Herts County boundary on the same schedule of prices as the firm is constructing the line along Ballard's Lane from Tally Ho Corner to Woodberry Grove.

Sydney.—The E.L. Committee has recommended the acceptance of Messrs. Noyes Bros.' tender for the supply of paper-insulated lead-sheathed cables, at £5,248.

Walthamstow.—The U.D.C. has accepted the tender of Mr. A. C. Burnley, to pay £25 per car per annum for three years for the right of advertising on its tramcars, and has also placed an order with the Westminster Engineering Co. to repair four armatures, at £45 each.

Worksop.—The U.D.C. has accepted the tender of Messrs. Chamberlain & Hookham, Ltd., for the supply of electric meters, and that of the Pulsometer Engineering Co. for the supply of water softening plant, at £200.

FORTHCOMING EVENTS.

To-day's Events (Friday, December 1st).—At 7 p.m. N.E. Coast Institution of Engineers and Shipbuilders. Dinner at Westgate Assembly Rooms, Newcastle.

At 7.30 p.m. Northampton Institute Engineering Society. Mr. W. Chappell on "Water Turbines as Applied to the Generation of Electricity."

Saturday, December 2nd. At 7.30 p.m. Glasgow Technical College Scientific Society. Dr. James Muir on "Metallography."

Monday, December 4th.—At 8 p.m. Society of Arts. Cantor Lecture, by Dr. J. A. Fleming, on "The Measurement of High-Frequency Currents and Electric Waves." (Lecture II.)

Thursday, December 7th.—At 8 p.m. I.E.E. Meeting at I.C.E. Mr. W. H. Patchell on "The Charing Cross Co.'s City of London Works."

At 8 p.m. Civil and Mechanical Engineers' Society. Meeting at Caxton Hall.

At 8.30. p.m. Chemical Society Meeting.

Friday, December 8th.—At 7.30 p.m. I.E.E. (Manchester Students). Mr. W. H. M. Parr on "The Electrification of Existing Steam Railways."

At 7 p.m. I.E.E. Annual dinner at the Hotel Cecil.

At 8 p.m. At Northampton Institute. Prize distribution by Sir Wm. Preece, and Conversazione.

At 8 p.m. Physical Society Meeting.

Saturday, December 9th.—Glasgow Technical College Scientific Society. Fourteenth Anniversary Dinner.

Monday, December 11th.—At 8 p.m. Society of Arts. Cantor Lecture, by Dr. J. A. Fleming, on "The Measurement of High-Frequency Currents and Electric Waves." (Lecture III.)

At 7.30 p.m. I.E.E. (Manchester.) Mr. H. Harrison on "Street Lighting."

Tuesday, December 12th.—At 8 p.m. I.E.E. Meeting. (Glasgow.)

Wednesday, December 13th.—At 7.30 p.m. I.E.E. Meeting. (Birmingham.)

At 8 p.m.—Association of Engineers-in-Charge. Mr. J. W. Blakely on "High-Pressure Gas Illumination."

Thursday, December 14th.—At 3 p.m. Tramways and Light Railways Association. Visit to Lot's Road power station.

At Rugby.—Rugby Engineering Society. Mr. P. A. Mossay on "High-Lift Pumps."

Friday, December 15th.—At 7 p.m. Physical Society. An Exhibition of Electrical, Optical and Physical Apparatus.

Saturday, December 16th.—At 7.30 p.m. Glasgow Technical College Scientific Society. Mr. W. D. Hamilton on "The Economy of Power Production—Relative Merits of Gas and Steam Engines for Various Purposes."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, December 4th.—"A" Company, recruits' drill, 6 p.m.; technical instruction, 7 p.m.

Tuesday, December 5th.—"B" Company, technical instruction, 7 p.m.; medical inspection, recruits, 7 p.m.

Wednesday, December 6th.—"A" badge examination, 7 p.m.

Thursday, December 7th.—"C" Company, technical instruction for the whole company at 7 p.m.

Friday, December 8th.—"D" Company, technical instruction, 7 p.m.

Saturday, December 9th.—Chelmsford detachment, all day instruction. N.C.O.'s mess dinner, Anderton's Hotel, 7 p.m. for 7.30.

J. H. S. PHILLIPS, Captain E.E.,
For O.C.E.E.R.E. (V.).

NOTES.

The Fulham Baths Arbitration.—On another page we report the hearing of the Borough Council's claim for damages against the National Electric Construction Co., Ltd., the contractors, in respect of two fatal accidents at the Public Baths on December 23rd, 1902. The following are taken from the award of Mr. James Swinburne, the Arbitrator, which was referred to in the hearing:—"I find as a fact that the accident which occasioned the deaths above referred to was caused by the fact that certain iron pipes forming part of the installation supplied by the contractors under the said contract were not earthed. If the said pipes had been earthed, the accident would not have happened. The omission to earth the said pipes was a matter of design, and not a matter of materials or workmanship, and was patent to any electrical engineer inspecting the installation. Apart from a reference to the rules of the Phœnix Fire Office, no indication was given on behalf of the Council to the contractors by drawings, specification, or otherwise, that they were required to earth the pipes. Having regard to the state of knowledge among electrical engineers at the time of the contract and of the execution of the works, I have come to the conclusion that the omission to earth the pipes under all the circumstances of the case, did not indicate a want of reasonable care or skill on the part of the persons responsible for the omission. Assuming that the contractors were responsible for the omission, I find, as a fact, that they were not guilty of want of reasonable care or skill in omitting to earth the said pipes. It was admitted before me that so far as this arbitration is concerned, the Council did not rely on any defects in the installation other than the omission to earth the said pipes. With regard to the rule of the Phœnix Fire Office above referred to, I find, as a fact, that in the case of the said pipes, earthing would not have been desirable so far as the risk of fire is concerned. It would, in fact, have been desirable so far as risk of accident to bathers is concerned. The buildings and the electrical installation were inspected and passed in April, 1902, by the surveyor of the Fine Art and General Insurance Co., who were the fire office concerned in the risk. I find that the Council have expended the sum of £1,173 13s. 1d. in respect of the matters in dispute in this arbitration, and that if they are entitled to recover against the contractors in this arbitration by way either of indemnity or of damages, that is the sum which they are entitled so to recover. The question for the opinion of the Court is, whether upon the facts herein stated the Council are entitled to recover the said sum of £1,173 13s. 1d. from the contractors in this arbitration. If the Court answer the above question in the affirmative, then I find and award that the Council are entitled to recover from the contractors the said sum of £1,173 13s. 1d., and I award and direct that the contractors do pay to the Council their costs of the reference, and also the costs of this, my award. If the Court answer the above question in the negative, then I find and award that the Council are not entitled to recover anything against the contractors, and I award and direct that the Council do pay the contractors their costs of the reference, and also the costs of this, my award." The award was stated in the form of a special case for the opinion of the Court, and the Legal Committee of the Borough Council were advised by counsel that they ought to argue before the Court the points of law reserved.

Christmas Boxes.—The following is a copy of the circular which members of the National Electrical Manufacturers' Association (Incorporated) are now sending out in response to applications for Christmas-boxes or New Year's gifts:—

"I beg to inform you that, at a recent meeting of the members of the above Association, it was unanimously decided that, owing to the enormous increase in the number of applications, they must reluctantly discontinue, as from this date, the practice of subscribing to Annual Beanfeasts, Christmas-boxes, New Year Gifts, &c. In consequence thereof the members of the above Association have unanimously agreed to discontinue this custom.

"WALTER DAVENPORT, *Secretary.*"

Indian Electrical Developments.—*Electrification of the Kalka-Simla Railway.*—Mr. J. W. Meares, the electrical adviser to the Indian Government, has virtually vetoed this project, by reporting that the expense would be prohibitive. Prospective concessionaires who had ear-marked a waterfall 120 miles distant, are, therefore, the probable reason of inspired paragraphs appearing in sundry Indian papers respecting the present heavy cost of fuel and engine repairs on this narrow-gauge line with its sharp curves and heavy gradient. Nevertheless the traffic is exceedingly sparse, and although Mr. Meares's advice may be unwelcome in certain quarters, it has, what the project has not, the advantage of a sound and economic basis.

The Calcutta Port Commissioners propose to install a 75-KW. electric generating set and necessary switchboard at their power house at Garden Reach for dealing with a lighting load. The estimated cost is Rs. 11,250.

The Difficulties of Cable Laying.—The overland edition of the *Indian Daily News* contains an account of a fracas at Howrah, where Mr. L. L. Robertson, an assistant electrician in the employ of the Calcutta Electric Supply Co., was mobbed and injured by stones and sticks. The cables were being laid on the solid system, and bitumen was being poured into the troughing, across which the passers-by insisted on walking. Mr. Robertson warned them not to do so, as even hardened Asiatic feet are not proof against molten bitumen. His advice was received with abusive language, and subsequently with brickbats and sticks. On the arrival of the police the row subsided, but on their departure, was resumed with added virulence. It was then that Mr. Robertson was injured. The police returning made several arrests, and the whole matter is now under investigation.

Electric Tramways in Cawnpore.—The *United Provinces Gazette* gives, in a recent issue, the agreement between the Cawnpore Municipality and the Cantonment Committee. A track rental of Rs. 1,500 per mile per annum of single track is to be paid, rent to commence when the Government has certified the tramway as fit for traffic. Also the Cantonment Committee has the right, if it provides the poles and fittings, to call upon the licensees to provide energy for the lighting of any street through which the tramways run, at a price not exceeding three annas per unit.

Electric Lighting of Indian Trains.—The Director of Railway Construction has recently issued for the purpose of information to all concerned, copies of two reports on this subject. The first concerns the Jodhpur Bikana Railway, which is using the Stone system, and the second the Rajputana Malwa Railway, which is employing the Independent Storage Battery system. The former being a metre gauge line, carries the generating dynamo and accumulators in the front and rear brake vans, the circuits on the various vehicles being connected up by means of flexible cables between coach and coach. Each of three trains equipped with the Stone system has 46 five-candle power lamps, and the cost of maintaining the lighting of each train was just over Rs. 905 (or £56 10s. sterling). This figure does not include any allowance for depreciation, but includes the cost of new belts (a relatively heavy item) and repair and replacement of parts of the accumulators. The cost of maintenance per five candle-power lamp hour works out at 1·42 pies (·088 pence) as against 1·75 pies (·109 pence) per oil-lamp hour (C.P. unstated and problematical) for oil alone.

The report on the Independent Storage Battery system reveals a higher cost of operation, and certain defects due to the batteries themselves which are taken off the train and recharged at a couple of special depôts. Hermetically sealed batteries were abandoned

on account of the difficulty of ascertaining the specific gravity of the electrolyte, its height, and the condition of the plates, while the compound used for sealing the cells gave rise to short circuits. An open-type cell with removable vulcanite top, rendered both inspection and tampering an easier matter, the latter taking the form of the addition of filth and nitric acid. Despite this, and the breaking of the lugs of the positive plates, the system has given every satisfaction. The cost per candle-power-hour (not per five candle-power-lamp-hour) for 3½ years, worked out at an average 0·63 pies (·044d.). This higher figure is, no doubt, due in part to the cost of power, and maintaining the staff at the generating stations.

New Licence for the Calcutta Electric Supply Co.—A new comprehensive draft licence in substitution for four earlier licences is now under critical consideration in Calcutta. The critical aspect is due to the fact that the consumers consider that the present agreeable dividends received by the shareholders, mean that the sliding scale tariff on which their bills are calculated, is not agreeable to the consumers themselves. For the rest the draft licence contains schedules of areas within the limits of supply, terms of purchase, &c. The following paragraph is the only one calling for quotation:—"The system of supply will be by continuous current generated within the limits of low-pressure supply, distribution being effected on the three-wire system at a declared pressure of 225 volts between the neutral conductor and either of the outers, or at 450 volts across the outer conductors, with the necessary consents." The neutral wire is to be earthed at the generating station only. "The mains distributing mains, and service lines, will be partly underground and partly aerial." Where the licensees install overhead wires along or across any street, they are to pay a rent to the Calcutta Corporation of 1 rupee for each post, and 2 rupees for each tripod, the rent being paid on the first day of January in each year.

Electrical Engineers R.E. (Vols.) Regimental Dinner.—On Saturday last the annual regimental dinner of the Corps was held at the Café Monico, the officer commanding, Lt.-Col. R. E. B. Crompton, C.B., presiding. There was a very large muster of the members and their friends, and a number of distinguished guests, including Col. W. Pitt, R.E., Col. N. M. Lake, R.E., Lieut.-Col. Sir E. P. C. Girouard, R.E., K.C.M.G., Major Baker Brown, R.E., Major Leggatt, R.E., Prof. Perry, Mr. Wolff Barry, and others.

After the loyal toasts and the photographer, Lt.-Col. Crompton proposed "The Army," eulogising the Royal Engineers, who were the model for the Electrical Volunteers to copy. Col. Pitt, in reply, expressed his pleasure in that, though he was no longer inspecting officer of the Volunteers, he was still closely connected with the corps, as commanding officer on the East Coast; the connection between the R.E. and the E.E. Volunteers was closer than that between any other Regular and Volunteer corps. The Electrical Engineers had served with distinction in South Africa, and he would like to see detachments of them joining the Regulars in manœuvres with their searchlights.

Proposing "The Corps of Electrical Engineers," Col. Lake said that his duties as inspecting officer of the corps afforded him very great pleasure. He found the Volunteers in camp engaged in the actual duties that they would perform in time of war, and he thought the collaboration between them and the Regulars was beneficial to both sides. The record of the corps was one that any unit in the service might be proud of. Returning thanks, Col. Crompton claimed for the corps some value as an educational force in London, and believed that eventually the corps would consist of a more intelligent and capable body than had ever existed.

Afterwards "The Guests" were toasted by Major B. Hopkinson; Lt.-Col. Sir E. P. C. Girouard and Prof. J. Perry replied.

During the evening a musical programme was performed, and the winners of the corps prizes were announced as follows:—

I. Officers' Cup (for shooting):—"C" Company.

II. Hopkinson Cup and Medals (Technical Competition):—"D" Company. Silver medals, C.S.M. (now Lt.) Thorn, Sergts. Van Zyl, Macgregor, Corpl. (now Sergt.) Zoephel, Sappers Schultz, Shove, Robinson, Outram.

2nd Team, "A" Company. Bronze medals, C.S.M. Mathews, Corpls. Gibson, Vitty, L.-Corpl. Capito, Sappers Dixon, Coles, May, Parker.

III. Leaf Cup (Individual Shooting, Morris Tube):—Sapper Bartram, Chelmsford Det.

IV. Spoon Shooting:—Sappers Gulland (2), Luck, Adams (1 each).

V. Inter-Company Morris Tube Competition:—"A" Company. Possible points, 35. Badges to Sappers Gulland (34), Buttemer (32), Corpl. Gibson (30), Sapper Johnson (26), Sapper Luck (26), Corpl. Bennett (16).

Steam Plant Economy.—It is the aim and duty of every good running engineer to strive after perfection—often elusive—in the condition and economy of the plant under his charge: the plant must be always in the "pink of condition," and the method of running it such as to get the greatest efficiency from its use. These two desiderata are parallel, and the engineer who loses sight of either, gives evidence of incompetence. On this subject of steam plant economy, Mr. Wm. M'Kay has made some remarks in his paper entitled "Suggestions for Steam Economy," read before the Canadian Electrical Association recently. He commences with some elementary questions of boiler design. A grate, he says, should not be over 7 ft. in length, or more than 5 ft. in breadth, owing to the difficulty of efficiently firing a larger area. The quantity of coal which can be burned on this, depends on the quality of the fuel and the strength of draught, and varies between wide limits. For good economy in steam generation, that is to say, to be able to exact the maximum of heat from the combustion of the fuel, boilers should have a certain minimum area of heating surface per "horse-power" developed, which he gives as follows:—

Lancashire and internally-fired types ...	9 to 10 sq. ft.
Water-tube	10 to 11 sq. ft.
Return tube	12 sq. ft.

Economy in burning fuel is a matter of great importance, and too much attention can hardly be given to obtaining good firemen; this point, the author remarks, is often neglected, and much thought given to getting first-class engines and condensers while the most fruitful source of loss is in the boiler room. He advocates the use of large boilers, but we think it possible to err on the wrong side here, for a large boiler, if not very frequently run, becomes a large drain on the profits, apart from the inconvenience it may cause if laid by for repairs.

Continuing, reference is made to the economy of high-pressure steam, the necessity of clean heating surfaces, and losses by air leakage, heat radiation and absorption. Prof. Hitchcock, of Ohio State University, is quoted as authority for the statement that a brick setting may continue to absorb heat for as much as three days from starting, and that the waste of heat from this cause may amount to 8½ per cent. of the fuel burnt. Our experience with large boilers tends to confirm this statement—given as the results of experiment—and where boilers are run intermittently this may cause serious loss.

The heating of feed water is an economy which should never be neglected; the exhaust from feed pumps and auxiliaries may be used to heat the water to 212° if, as a preliminary, it has been passed through economisers or heaters run on the exhaust from the main engines.

With reference to engines, the author recommends compound condensing engines for steady work when the plant is of sufficient size to warrant the capital outlay, but under other conditions the simple single cylinder engine may pay the best and cost less for repairs. He prefers the Corliss gear. For small stations with a variable load requiring close and quick governing his vote would be given for high-speed enclosed engines as requiring least attention, and on the ground of reliability.

As instance of the small amount of wear in high speed engines, he refers to a Robb-Armstrong engine of 12 in. stroke and running at 275 revolutions per minute, which after 12 to 14 years' working was found to have worn 0·002 in. in the journals and 0·006 in. in the shaft bearings.

Touching on steam piping, the author has something to say of the smallness of steam piping in a large number of stations in Canada, to which he attributes considerable loss of pressure between boiler and engine, but he also speaks favourably of the device of throttling the steam at the boiler stop valve when running lightly loaded, with a view to reducing condensation in the pipes.

The paper has evidently been written with reference to some American power plants of small size.

The L.B. & S.C. Railway Single-Phase Line.—A correspondent of the *Times Engineering Supplement* writes:—"I understand the London, Brighton and South Coast Railway Co. are preparing to go ahead with the electrification of their South London line on the single-phase system. It is believed the contract will be undertaken by the Allgemeine Elektricitäts Gesellschaft."

Electric Shock Fatalities.—With reference to the paragraph on p. 855 of our last issue respecting the death of Robt. M'Aulay, the following is a report of the inquest, presumably on the same case, though the name of the victim, it will be observed, is different.

An inquiry was held at Linlithgow on 21st ult. "as to the death of Robert M'Quillan, labourer, Broxburn, who was fatally injured in Winchburgh Oil Works by coming in contact with a live electric wire. Mr. Black, the manager, said there were two electric wires about 18 in. apart where deceased met with the accident, and marks on his neck indicated that he had touched one of the wires with the back of his neck, and he, feeling the sting, rushed forward so that the front of his neck touched the other wire. When they earthed the wire they found a current of 300 volts, which, in his opinion, was not sufficient to cause death. The deceased's clothes, being wet, were, however, against him. The jury's verdict was to the effect that death was due to deceased coming in contact with a live wire."—*Edinburgh Evening Despatch.*

An electrical engineer at the Roodepoort Central Deep Mine was electrocuted last month, through grasping a 1,500-volt live cable.

Collecting-Boxes in Tramcars.—For some time past, with the approval of the general manager of the Croydon Tramways, Mr. T. B. Goodyer, two small collecting boxes have been placed in each car for the benefit of the local hospital, and the results have been very encouraging. For some years past, also, the Croydon tramway employés have each contributed a penny or two per week towards the hospital funds, the aggregate amounting to a considerable sum. In recognition of his efforts in the cause of humanity, the Hospital Committee recently appointed Mr. Goodyer to be an hon. life governor of the hospital, and we think the example that he has set might well be followed by others. The trouble involved is trifling (though that should not exert much influence), while the results may be very appreciable.

Nothing Like Leather.—From the daily Press:—On the electrified District Railway first, second, and third-class have been replaced by special, ordinary, and strap. About 75 per cent. of the passengers travel strap.

Institution and Lecture Notes.—At the Nottingham University College on Saturday last, Mr. W. C. Mountain delivered his second lecture on "Electricity as Applied to Mining."

On Monday evening last, Mr. A. A. Blackburn, the superintendent, gave a lecture at Belfast to drivers and conductors and others on the equipment, &c., of the Corporation tramways.

Ipswich Engineering Society.—At the meeting of this Society held on Monday last week, Mr. Frank Ayton, chief electrical engineer to the Corporation, who is the newly-elected president, delivered an address on "Present-Day Features in the Generation, Distribution and Utilisation of Electric Power."

Society of Arts.—At the meeting held on November 15th, the Chairman presented the Society's medals, which were awarded for papers read during last session, including the following:—

To Mr. Charles Denton Abel, for his paper on "The Patent Laws."

To Capt. Lionel James, for his paper on "Wireless Telegraphy and War Correspondence."

To the Hon. Robert P. Porter, for his paper on "London Electric Railways."

Victorian Electrical Association.—An Australian exchange says that the first important business meeting of this recently formed Association was held at Melbourne recently, under the presidency of Mr. Henry Noyes. About 40 representatives of the profession were present. The principal business was the presentation of the report of the sub-committee which was appointed to draft rules and regulations on the lines suggested at the recent smoke night—viz., social gatherings, reading and discussion of electrical papers, and generally to further the interests of the profession. A provisional council, consisting of Messrs. W. F. Clements, H. R. Harper, A. U. Alcock, A. E. Woodhouse, W. H. Alabaster, Noel Murray, H. Clement Newton, with the secretary, Mr. T. L. Coleman, was appointed to classify candidates as members and associates. It is expected that the Association will start with a roll of 80 members.

The Safety of Electrical Apparatus.—The *Times'* Berlin correspondent states that at the seventh annual meeting of the Institute of German Naval Architects in the Charlottenburg Technical College, on the occasion of the German Emperor's visit, the chief paper was that contributed by Prof. Kübler, of Dresden, upon "The Supposed Dangers of Electrical Apparatus and Plant." By means of a series of experiments the lecturer demonstrated that the danger to life and limb from electrical plant and fittings had been reduced to a minimum, and an extensive inquiry among electrical engineers showed that the annual averages of deaths and injuries caused by electric shock were respectively ·03 and ·07 per factory. The danger of fire from electrical fittings was likewise infinitesimal. During the course of the discussion which followed, it was stated that, despite the manifold uses to which electricity is put in the German navy, no fatal accident had hitherto resulted in consequence.

North Wales Electric Power Scheme.—On the approaching completion of their transmission lines for the North Wales Power and Traction Co., Ltd., Messrs. Bruce Peebles & Co., Ltd., electrical engineers, Edinburgh, gave a very successful dinner at the Victoria Hotel, Llanberis, on Saturday last; close on 200 guests sat at the well-spread tables, Mr. Pickstone, of Bruce Peebles and Co., presiding. After the loyal toast, Mr. Brinkman, of the Dinorwic Quarries, proposed the "Health of the Power Co.," which was replied to by Mr. Taylor, superintendent of works representing Messrs. Harper Bros. & Co., engineers of the scheme.

Mr. T. Kerr (Messrs. W. Kerr & Co., Glasgow) proposed the health of Messrs. Bruce Peebles & Co., Ltd., and referred to the fact that although the firm had only started operations eight years ago, they had had to erect a large new shop, and contemplated a further early addition, while the number of men employed had yearly doubled.

Mr. Pickstone responding, stated that he considered their success due to fortunate choice of a capable and energetic staff. This contract had proved a record in many respects—30 miles of transmission lines having been erected in the course of five months, and much of this in almost inaccessible places. The scheme was also unique in character, being the first high tension hydro-electric power scheme in this country with transmission by bare overhead conductors. Three-phase alternating current was generated by alternators direct driven by Pelton wheels, the head of water being 1,100 ft., and the turbines were fed by a duplicate pipe line 1¼ miles long with pipes 30 in. in diameter. Each of the four sets of engines already installed would develop 1,500 K.V.A., the power being used principally in the slate quarries situated within a radius of 15 miles. The power also served to supply current to the North Wales Narrow Gauge Railway and its extensions, all of which had been carried out by the firm, the result being a complete narrow-gauge line from Carnarvon to Portmadoc. The line when completed and electrified would be 30 miles long, with nine transformer stations, the pressure being transformed to 600 volts. He also referred to the many very large contracts that the firm have at present on hand, not only in Great Britain, but also in Canada, South Africa, China and South America. With regard to the North Wales scheme, he further desired publicly to commend their local managing engineer, Mr. W. Vincent Waite, their electrical engineer, Mr. A. W. Beutell, and also the remainder of their staff for their valuable and energetic assistance in carrying out the contract.

Other toasts and a musical programme followed.

Appointments Vacant.—Telegraph inspector for the Federated Malay States (£225); electrical mechanician for the Federated Malay States Railways (£225).

The Olympian Electrical Exhibition.—We learn from Mr. W. Davenport, the Secretary to the Executive Committee, that the financial affairs of the recent Exhibition are now so far advanced as to enable him to announce that the exhibitors will receive a rebate of 25 per cent. upon the sums paid by them for space, and a very considerable sum will be available for benevolence.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

Central Station Engineers.—The Heston and Isleworth U.D.C. has expressed its satisfaction with the services of its chief assistant engineer, Mr. J. Arthur Sykes, and has, at the end of 12 months' service, increased his salary from £130 to £150 per annum.

The Burnley Board of Guardians has appointed Mr. Ernest F. Jackson, of St. Annes, as electrical engineer at the Union Workhouse.

We learn from a Newcastle newspaper that "Mr. J. F. C. Snell, electrical engineer to the Sunderland Corporation, has been appointed electrical adviser to the London County Council. He, however, will still retain his position at the Wearside borough."

General.—An Indian exchange says that Mr. T. E. Tebbutt, electrician, Indo-European Telegraph Department, is gazetted for 12 months' leave.

On Friday evening, at the King's Arms Hotel, at Sheffield, Mr. J. McNamara, who for the past two years has held the post of works superintendent in the electrical department of Messrs. Vickers, Sons & Maxim, Ltd., Sheffield, was presented by the members of the staff with a kit-bag and case of razors on the occasion of his leaving to take up an important appointment in Egypt. On Saturday evening, at the same hotel, Mr. W. Baxter was presented by the members of the staff with a silver cigarette case, a travelling flask and a fountain pen, on the occasion of his departure from Sheffield to take up an appointment as manager of an electrical stampings department for Mr. E. Stevens, Stour Works, Cradley Heath. For the past 2½ years Mr. Baxter has been assistant designer in the electrical department of Messrs. Vickers, Sons and Maxim, Ltd., Sheffield.

It is announced that the value of the estate of the late Mr. Alfred Morcom, chairman of Belliss & Morcom, Ltd., amounted to £217,017.

Obituary.—We regret to announce that the death of Sir John Burdon Sanderson took place at Oxford, on 24th ult., in his 77th year. His name is most intimately associated with bacterial physiology. The *Times*, in a detailed account of his career, says that among his multifarious scientific researches were those of the supposed electrical capacities of plants, which were undertaken at the suggestion of Charles Darwin. Later, Sir John made further researches of the highest value in the electrical organs of the skate and of the sensitive plant Dionæa. He was president of the British Association for the Advancement of Science at Nottingham in 1893. He was made a baronet in 1899. He resigned his position of Regius Professor of Medicine at Oxford University early last year.

NEW COMPANIES REGISTERED.

Health Culture Co., Ltd. (86,582).—This company was registered on November 23rd, with a capital of £6,000 in £1 shares (570 6 per cent. cumulative preference, 5,000 ordinary and 30 founders') to acquire (1) the business of the Health Culture Co., carried on at 22, Budge-Row, E.C., and (2) the business of the Appariel Magnetique Co., carried on at 9, Walbrook, E.C., to adopt an agreement with J. Nicholson, to disseminate information relating to physical development and the cultivation of health generally, and to carry on the business of medical electricians and magneticians, electrical masseurs and therapeutists, manufacturers of and dealers in all kinds of electrical, surgical and gymnastic appliances and implements, &c. The first subscribers (each with one share) are:—J. Nicholson, 22, Budge Row, E.C., medical electrician; H. Bastow, 147, High Street, Homerton, N.E., merchant; H. O. Goodwin, 147, High Street, Homerton, N.E., merchant; J. W. James, 58, Wilton Avenue, Chiswick, manager; T. Webber, 22, Heathfield Street, South Croydon, clerk; E. Kilbey, 34 and 36, Gresham Street, E.C., clerk; G. L. Gallot, 34, Gresham Street, E.C., clerk. No initial public issue. The ordinary shares carry a non-cumulative dividend of 10 per cent. before any payment is made on the founders' shares. The number of directors is to be three; the first are J. Nicholson, H. O. Goodwin and H. Bastow; qualification, £100; remuneration (except managing director) as fixed by the company.

Imperial Automatic Light, Ltd. (86,560).—This company was registered on November 22nd, with a capital of £10,000 in £1 shares, to adopt an agreement with the United Engineering Co., Ltd., and to carry on the business of lamp manufacturers, producers and suppliers of acetylene or other gas, oil and electric light, manufacturers of calcium carbide and like products, electricians, engineers, &c. The first subscribers are:—H. Compton, 22, Albert Court, South Kensington, gentleman, 100 shares; G. T. Temple, Solheim, Cumberland Park, Acton, W., Lieut. R.N. (retired), 100 shares; A. Akers, 31, Walbrook, E.C., chartered secretary, 100 shares; F. J. Donegan, 4, Tokenhouse Buildings, E.C., stockbroker, 1 share; R. D. Munro, 20 and 21, Lawrence Lane, E.C., chartered accountant, 1 share; F. O. Hall, 61, West Smithfield, E.C., solicitor, 1 share; E. Wallington, 61, West Smithfield, E.C., managing clerk, 1 share. Minimum cash subscription £1,000. The number of directors is not to be less than three nor more than five; the first are H. Compton, G. T. Temple and A. Akers; qualification, £100; remuneration as fixed by the company. Registered office, 23, 25 and 27, Station Buildings, Haggerston, N.

Automobile Cab Co., Ltd. (86,557).—This company was registered on November 22nd, with a capital of £100,000 in £1 shares, to carry on the business of motor cab, carriage, car, omnibus and van proprietors, carriers of passengers and goods, constructors of and dealers in steam, oil, electric or other motor vehicles, cycles, locomotives, accumulators, dynamos, &c., and to adopt an agreement with the Central Motor Car Co., Ltd. The first subscribers (each with one share) are:—H. L. Bankes, 33, Cornhill, E.C., clerk; H. T. Holmes, 166, Wilmot Street, E., book-keeper; H. J. Pexton, "Kildare," Honor Oak Park, S.E., clerk; R. de P. M. Bird, 33, Cornhill, E.C., clerk; H. P. Geard, 33, Cornhill, E.C., articled clerk; J. A. Roney, 33, Cornhill, E.C., secretary; and B. B. Bennett, 33, Cornhill, E.C., solicitor. Minimum cash subscription £100. The number of directors is not to be less than two nor more than seven. The subscribers are to appoint the first; qualification £250. remuneration, £200 each per annum (chairman £100 extra) and 10 per cent. of the distributed profits in excess of 10 per cent. on the paid-up capital divisible. Registered office, 7 and 8, Walbrook, E.C.

Automatic Electric Block Signalling Co., Ltd. (86,590).—This company was registered on November 24th, with a capital of £1,000 in £1 shares, to adopt an agreement with the Electric Railway Signalling Syndicate, Ltd., to acquire any patents and inventions, and to carry on the business of electricians, engineers, suppliers of electricity and electrical installations and machinery for light, signalling, heat, motive power or other purposes, manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—F. T. Carter, 68, Palmerston House, E.C., accountant; A. J. Pegg, 68, Palmerston House, E.C., clerk; H. J. Coleman, 68, Palmerston House, E.C., clerk; W. T. Johns, 68, Palmerston House, E.C., secretary; J. Pasfield, 68-74, Palmerston House, E.C., secretary; T. A. Cassini, 68-74, Palmerston House, E.C., clerk; and H. W. Proctor, 68-74, Palmerston House, E.C., registrar. No initial public issue. The number of directors is not to be more than five; the subscribers are to appoint the first. Registered office, 302, Finsbury Pavement, E.C.

Crawford Electric Lamp Syndicate, Ltd. (86,578).—This company was registered on November 23rd, with a capital of £30,000 in £1 shares, to carry on the business of manufacturers, sellers and suppliers of electric lamps, suppliers of electricity, contractors for the construction, equipment and maintenance of electric lighting, central and other lighting stations and electrical works, electricians, electrical, mechanical, metallurgical and chemical engineers, &c. The first subscribers (each with one share) are:—H. L. Reed, 9, Portland Mansions, Oxford Circus, W., engineer; W. Chaplin, 9, New Broad Street, secretary; H. Staney, 32, Great St. Helens, E.C., secretary; W. Andrew, 38, Hornsey Park Road, Hornsey, N., accountant; F. C. Crawford, 17, Stratton Street, Piccadilly, W., gentleman; E. B. Parsons, 130, Dashwood House, E.C., clerk; and J. R. Crawford, 17, Stratton Street, Piccadilly, W., electrician. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration, £300 per annum, divisible.

Midland Counties Railway Syndicate, Ltd. (86,585).—This company was registered on November 23rd, with a capital of £1,000 in £1 shares, to carry on the business of tramway, railway, omnibus and van proprietors, carriers of passengers and goods, constructors of and dealers in tramway and railway carriages, trucks, locomotives, accumulators, dynamos and equipments, suppliers of electricity for light, heat, motive-power or other purposes. The first subscribers (each with one share) are:—W. W. Roper, 14, St. Helen's Place, E.C., clerk; W. J. Hill, 14, St. Helen's Place, E.C., shorthand writer; H. P. Dakin, 130, Holmesdale Road, South Norwood, S.E., clerk; R. J. Muggleton, 14, St. Helen's Place, E.C., clerk; A. E. Bullard, Burleigh, Chudleigh Road, Brockley Grove, S.E., clerk; W. A. Hill, 1, Colwell Road, East Dulwich, S.E., shorthand writer; and R. G. Cheshire, 14, St. Helen's Place, E.C., clerk. No initial public issue. The number of directors is not to be more than five; the subscribers are to appoint the first. No qualification required.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Car Trust Realisation Co., Ltd. (86,106).—A trust deed dated November 7th, 1905, to secure debenture stock for an unspecified amount, but stamped to cover £250,000, has been registered. Property charged: The company's property present and future, including uncalled capital. Trustees: J. G. Gordon, Queen Anne's Mansions, Westminster; and C. E. S. Bishop, 4, Throgmorton Avenue, E.C.

Hopper & Co., Ltd. (Electricians, Walthamstow) (86,118).—£2,900 debentures, created and dated November 9th, 1905, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Bombay Electric Supply and Tramways Co., Ltd. (85,055).—A trust deed, dated November 7th, 1905, to secure £600,000 debenture stock, with power to issue further debenture stock not exceeding (together with the present issue) half of the company's issued capital, has been registered. Property charged: (1) A concession from the Corporation of Bombay, dated August 7th, 1905; (2) The Bombay Electric License, 1905, and the Bombay Electric Traction License, 1905, and any licenses which may be vested in the company in substitution for or supplemental thereto; and (3) The company's undertaking and remaining assets, present and future. Trustees: The Rt. Hon. Lord Hillingdon, 67, Lombard Street, E.C., and G. Herring, 1, Hamilton Place, London.

Hubert Grenfell, Ltd. (43,086).—This company's annual return was filed on November 21st, when 10,000 ordinary and 1,345 preference shares had been taken up out of a nominal capital of £12,500 in 10,000 ordinary and 2,500 preference shares of £1 each; £1 per share has been called up on the preference and £1,345 has been received; 10,000 ordinary shares are considered as fully paid. Mortgages and charges: Nil.

Monte Video Telephone Co., Ltd. (27,208).—This company's annual return was filed on November 15th, when 86,492 preference and 72,680 ordinary shares had been taken up out of a nominal capital of £160,000 in 87,000 preference and 73,000 ordinary shares of £1 each; £159,172 is considered as paid. Mortgages and charges: Nil.

Tasker, Sons & Co., Ltd. (78,374).—This company's annual return was filed on September 12th, when 5,089 ordinary and 6,815 preference shares had been taken up out of a nominal capital of £50,000 in 20,000 preference and 30,000 ordinary shares of £1 each; £2,554 has been received, and £9,300 is considered as paid. Mortgages and charges: Nil.

Marconi International Marine Communication Co., Ltd. (65,759).—Issue on November 20th of £8,000 debentures, part of series created same date, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

British Electric Co., Ltd. (London) (83,338).—Issue on October 13th of £50 debentures, part of series created same date, to secure £250, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Keynsham Electric Light and Power Co., Ltd. (64,634).—Issue on November 9th of £1,104 debentures, part of series created same date to secure £1,500, charged on certain land and buildings occupied by the company at Keynsham, Somerset, and the company's undertaking and property, present and future, including uncalled capital, subject to £1,500 first debentures. No trustees.

New Century Arc Light Co., Ltd. (67,849).—This company's annual return was filed on November 4th, when 14,306 ordinary and 5,000 preference shares had been taken up out of a nominal capital of £30,000 in 25,000 ordinary and 5,000 preference shares of £1 each. £1 per share has been called up on 2,506 ordinary shares, resulting in the receipt of £2,506. £16,800 is considered as paid on 11,800 ordinary and 5,000 preference. Mortgages and charges: £7,500.

British Prometheus Co., Ltd. (74,889).—This company's annual return was filed on September 22nd, when the entire capital of £5,000 in £1 shares had been taken up, £2,500 having been received, and £2,500 being considered as paid. Mortgages and charges: £3,000.

Prested Miners' Gas-Indicating Electric Lamp Co., Ltd. (76,081).—This company's annual return was filed on November 18th, when 16,500 shares had been taken up out of a nominal capital of £20,000 in £1 shares. £1 per share has been called up on 7,500, and 5s. per share on 1,500 shares, resulting in the receipt of £7,872 10s., £2 10s. remains in arrears. 7,500 shares are considered as fully paid. Mortgages and charges: nil.

Electrical Corporation, Ltd., London (62,630).—A charge on book debts and sums of money due to the corporation and its undertaking and property, present and future, including uncalled capital, dated October 31st, 1905, to secure £272 2s. 6d. and further advances up to £800, has been registered. Holders: E. S. Parker and A. H. H. Richardson, both of 52, New Broad Street, E.C.

New St. Helens and District Tramways Co., Ltd. (59,426).—This company's annual return was filed on November 17th, when 15,980 preference and 9,000 ordinary shares had been taken up out of a nominal capital of £150,000 in 20,000 preference and 10,000 ordinary shares of £5 each. £5 per share has been called up, resulting in the receipt of £125,410, including £510 paid on 1,020 forfeited shares. Mortgages and charges: Nil.

ELECTRICITY SUPPLY ACCOUNTS.

Durban (Natal) Municipal Electricity Supply.

We deal this week with the returns of the Durban undertaking, for the year ending July 31st, 1905, which, in spite of the continued depression in South Africa, continues its successful career. The supply is on both the alternating and direct current systems, and distribution for the residential portion of the town is carried out by bare overhead mains, which are in process of being changed over from a 2-wire to a 3-wire network, with 400 volts across the outers. Some 142 miles of overhead, and 112 miles of underground mains are in use. Economies have been effected during the year, measures taken in that direction including the fitting of mechanical stokers to some of the boilers, and the provision of additional economisers. An 800-kw. alternator has been added, and a storage battery and booster installed.

The economies have resulted in a saving of ·16d. per unit on the generating costs, and allowed the price of current to be reduced by 10 per cent. in the form of a discount for prompt cash.

General Statement for Year ended July 31st, 1905.

Total capital expended		£231,625
Number of units sold—Tramways		1,548,649 D.C.
Private motors		812,864 D.C. & A.C.
Private lighting		1,506,703 A.C.
Street lighting		551,435 D.C. & A.C.
Total number of units sold		4,419,651
Total number of consumers		3,167
No. of 8-C.P. lamps for private lighting		134,911
Horse-power of motors		1,173
Street lamps—Arcs		255
Incandescents		1,240
Tramway load in KW.		1,000
Revenue account.—		
Gross revenue	£76,703 =	4·16d. per unit
Gross expenditure	35,848 =	1·94d. per unit
Gross profit	40,855 =	2·22d. per unit
Average price obtained per unit sold.—		
Private supply—Light		7·88d.
Motors		2·71d.
Public supply		3·60d.
Tramways		1·25d.

Costs of Production.

Coal	£15,492 = ·842d.	per unit.
Oil and waste	774 = ·043d.	"
Water	670 = ·035d.	"
Wages	4,548 = ·244d.	"
Repairs	2,202 = ·122d.	"
Total generating costs	£23,686 = 1·29d.	per unit.
Underground and overhead mains	£2,284 = ·105d.	per unit.
House services	1,259 = ·058d.	"
Street lighting attendance	1,484 = ·069d.	"
Total distributing costs	£5,027 = ·27d.	per unit.
Salaries	£4,248 = ·197d.	per unit.
Sundries, rents, insurance, &c.	2,887 = ·134d.	"
Total general charges	£7,135 = ·38d.	per unit.
Total works cost	**£35,848 = 1·94d.**	"

PROFIT STATEMENT.

Interest on loans			£10,125
Depreciation			8,800
Special allowance			5,000
Suspense account			1,595
Outstanding accounts			1,583
Surplus on year's work ...	£14,526 15 3		
Less bad debts	774 14 6		
			13,752
Gross profit			£40,855

Though private consumers have increased by 20 per cent., there having been 581 added during the year, the energy used for private lighting has only increased by 11 per cent, and, considering the present depression, this was only to be expected.

The financial result, a net profit of £13,752, is a highly satisfactory feature, upon which the borough electrical engineer, Mr. John Roberts, is to be congratulated; and it fully warrants, as he suggests, a further reduction in the charges for supply.

The prices charged are:—For private lighting, 8d. per unit up to 500 units per month, with a discount of 10 per cent. for prompt cash, and a further discount of 15 per cent. above 500 units; motors from 2d. to 1d. per unit, depending on the quantity, plus a standing charge of £5 per H.P. per annum up to 5 H.P., and £3 per H.P. per annum for motors over 5 H.P.; tramways, 1½d. per unit.

ELECTRIC TRAMWAY ACCOUNTS.

Durban (Natal) Municipal Tramways.

THE returns of the electric Tramways system of the Durban Corporation for year ended July 31st, 1905, are of an interesting character. This system has been in operation for over three years, previous to which horse traction was in use, and the returns this year are such as can be better analysed than previously, as they are the results of electrical operation only.

The combined power station supplies current at 550 to 500 volts pressure, for which the tramway department is charged 1½d. per unit.

Particulars of rolling stock:—46 double-deck, 4-wheel cars; 2 sprinklers (1 4-wheel, 1 bogie truck); 3 stone wagons, 4-wheel; 6 trailers (radial trucks) recently received; 2 funeral cars (1 for natives, 1 for Europeans) recently received.

The traffic statistics for the past three years are as follows:—

	1903.	1904.	1905.
Car-mileage	1,039,186	1,032,350	1,097,230
Passengers carried	9,208,332	11,501,000	11,848,191
,, per car-mile ...	8·86d.	11·14d.	10·73d.
Average fare per passenger...	2·42d.	1·77d.	1·77d.
Traffic receipts, per car-mile	20·41d.	20·109d.	19·31d.

During the year the operating expenses were reduced from 11·77d. to 9·9d., and in spite of its being a year of depression, a considerable increase in traffic has resulted.

22 cars are run daily, and 22 specials are in use for the "rush" hours.

GENERAL STATEMENT for year ended July 31st, 1905.

Length of route	13·58 miles
Length of track	22 miles
Number of passenger cars...	46, also 6 trailers
Car-miles run	1,097,230
Passengers carried...	11,848,191
Capital expenditure	£420,000
Traffic receipts	£88,280
Total receipts	£89,669
Working expenses...	£45,307
Gross profit	£44,362

Income per car-mile	19·6d.
Working expenses per car-mile	9·9d.
Interest and sinking fund per car-mile ...	4·4d.
Total expenses per car-mile	14·3d.
Profit per car-mile...	5·3d.
Cost of energy per car-mile	1·77d.
Average fare per passenger	1·78d.

Total number of units used	1,548,649
Units used per car-mile	1·4

Percentage working expenses to receipts	**50·6%**

ANALYSIS OF OPERATING EXPENSES PER CAR-MILE.

Power	1·77d.
Traffic	5·25d.
General	·43d.
Maintenance	2·45d.
Total	9·90d.

PROFIT STATEMENT.

Interest and sinking fund	£20,292
Depreciation	9,143
Sundry charges	8,552
Surplus on year's working	6,375
Gross profit	£44,362

The manager, Mr. H. N. Thomas (late of the Huddersfield Corporation Tramways Department), is to be complimented on these successful results, and on the various improvements he has carried out during the few months since he was appointed.

CITY NOTES.

Companies to be Struck off the Register.

THE names of the following companies are to be struck off the register within three months, and the companies will be dissolved, unless cause is shown to the contrary:—

Anglo-Continental Electro-Medical Vapour Baths Co.
Atlas Electric Appliances Co.
British Electrical Manufacturing Co.
British Spiral Telephone Wire Syndicate.
City and Suburban Electric Carriage Co.
Electrical Insulator Manufacturing Co.
Electric Carbon Storage and Apparatus Manufacturing Co. of Scotland.
Electric Manufacturing Co.
"Electric" Paint Remover Co.
Electric Portable Battery and Gas Igniting Co.
Elwell-Parker, Ltd.
French Electrical Power Storage Co.
Morecambe Electric Launch and Power Syndicate.
Mutual Telephone Co. (Registered February 4th, 1890.)
Petroleum Engine Co. (Registered July 1st, 1884.)
Railway and Domestic Electric Lighting Co.
St. George Telephone Co.
South Kensington Mutual Electric Lighting and Supply Co.

Prospectuses.—*Newquay Electric Light Co., Ltd.*—The list is to close to-morrow, Saturday, in an issue of 15,000 shares of £1 each. The company is to take over the Parliamentary powers granted to Messrs. Foote, Milne & Owen in 1904 for electricity supply at Newquay, Cornwall. Messrs. Foote & Milne, Ltd., will construct the works and will join the Board on completion of the equipment. They have undertaken to pay not less than 4 per cent. dividend until the expiration of two years from the date when supply commences, provided that the profits, after making an allowance for depreciation for the second year, are not sufficient to pay that amount. The price of gas is 5s. per 1,000. The amount payable under the contract is £11,675, £9,000 in fully paid shares if so required, and £2,500 in first mortgage debentures.

Stratford-on-Avon Electricity Co., Ltd.—The list of subscriptions was opened on Wednesday, and will close on December 13th, in an issue of 9,000 £1 shares in this company. The company is to supply electric light and power in Stratford-on-Avon and neighbourhood, and carry out an agreement between the Corporation and the Birmingham Installation Co., which provided for the assignment of the provisional order to the present company. The total nominal capital is £15,000. Mr. Cecil D. Falcke, of Coleshill Street Electrical Works, Birmingham, is the engineer and secretary. The registered offices are at 42, Greenhill Street, Stratford-on-Avon.

Barcelona Tramways Co.—At an extraordinary general meeting on 27th ult. a resolution for winding up the company voluntarily was adopted. Mr. J. B. Concanon said they were anxious to close up the sale and distribute the assets. The balance of the purchase money (£387,000) was expected to be received on December 11th. The shareholders would receive at least 14s. 10d. per share.

Western Telegraph Co.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, for the quarter ended September 30th, 1905.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to—

British Aluminium Co., Ltd.—88,000 ordinary shares of £5 each, £2 paid.

The Mackay Companies.—A Reuter dispatch from New York, November 25th, says that the Mackay companies have completed arrangements by which the dividends of the Commercial Cable Co., the Postal Telegraph Co., and other allied cable, telegraph and telephone companies, to be issued to the English and Continental shareholders are, at the option of the shareholder, to be payable through the Union of London and Smiths Bank, London, at the rate of 4s. 1½d. to the United States dollar.

MARKET QUOTATIONS.

Wednesday, November 29th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	10d.	..
a ,, (50 %)	per gal.	9½d.	..
a Copper Sulphate	per ton	£22 10	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar..	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	190/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a Sodium Bichromate, casks ..	per lb.	2½d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£150	..
b ,, Wire, in ton lots ..	per ton	£177	..
b ,, Sheet, in ton lots ..	per ton	£175	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	8d.	½d. inc.
c ,, Tube (brazed)	per lb.	9½d.	½d. inc.
c ,, ,, (solid drawn).. ..	per lb.	9d.	½d. inc.
c ,, Wire, basis	per lb.	8½d.	½d. inc.
c Copper Tubes (brazed)	per lb.	11½d.	½d. inc.
c ,, ,, (solid drawn) ..	per lb.	11½d.	½d. inc.
g Copper Bars (best selected) ..	per ton	£91	60/- inc.
g Copper Sheet	per ton	£91	60/- inc.
g ,, Rod	per ton	£91	60/- inc.
e ,, (Electrolytic) Bars ..	per ton	£82	90/- inc.
e ,, ,, Sheets ..	per ton	£95	90/- inc.
e ,, ,, Rod ..	per ton	£86 10	40/- inc.
e ,, ,, H.C. Wire	per lb.	10½d.	½d. inc.
f Ebonite Rod	per lb.	8/3	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/3	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	52/11	6d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£16 5 to £16 7 6	17/6 to 20/- inc.
g ,, ,, Sheet	per ton	£18 2 6	17/6 inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 5	..
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	84/-	..
e Silicium Bronze Wire	per lb.	11d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£159 to £160	£5 inc.
n ,, Wire, Nos. 1 to 16	per lb.	1/10	..
p White Anti-friction Metals— "White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£31 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Japan and American Engines.—Under the heading "Faulty American Engines," the *Daily Express* says:—"Japan is making serious complaints about the locomotives supplied by the United States to the Imperial Government Railways. An official report speaks of leaky boilers and imperfectly fastened rivets, and states that none of the engines could be passed until they had been to the repairing shops. It is also stated that the engines are so badly made and improperly packed that they are liable to damage in transport."

STOCKS AND SHARES.

Wednesday evening.

Markets, owing to the easier condition of money rates, are in a fairly happy frame of mind, although the recurrence of more serious Russian trouble has given pause to buyers in all sections of the Stock Exchange. Moreover, the distressful Kaffir market is worrying the House almost as much as Home Rule confuses the Liberal Party. Money continues plentiful enough, at current rates, and the rush for the new Japanese Loan shows that investors have capital to spare, despite the advent of Christmas, with its toll of demands upon the pocket of the financial world and—more unpleasant still—that of the individual.

Improvements in the ensuing lists are to be found principally in the telegraph department. They occur chiefly in Debenture stocks, and are limited to ¼ per cent., in other words, they are the market's recognition of the approaching interest payments. In the list of shares, Amazons are 5s. lower, which is not surprising in view of the rapid rise they recently enjoyed. Reuter's are also ¼ lower at 7⅞; the market is limited, and two or three simultaneous sellers suffice to depress the price. Slight weakness in Marconi's shares has left the price $\frac{1}{16}$ lower at $1\frac{5}{16}$. The gamble in Anglo-American Deferred proceeds apace, but the buying is decidedly less aggressive, and the price of the stock remains almost stationary. Indo-Europeans put on 10s. at 58½. Henley new Debenture is 4 to 6 premium, and the old stock has now, at any rate theoretically, disappeared.

As regards telephones, National Deferred put on a point at 109, but the Second Preference shares have again broadened out in quotation to 11-13. Other descriptions show no change except for ⅛ rise in Chili Telephone shares.

Traction matters continue to take up a good deal of attention. The motor-'bus industry seems to attract popular interest, and proprietors of shares in the London General Omnibus and the Road Car companies are freely selling. London Motor-Omnibus shares, however, are flat at 2½, and the shares of the new Motor-'Bus Co. command a real premium of about 3s. 9d. We are glad to see the *Pall Mall Gazette* condemning the regrettable practice of issuing Deferred shares, a feature that disfigures several of the new motor concerns.

Anglo-Argentine Tramways shed ⅛, but are still 8⅝. Here the list of quotable changes ends, the market for electric traction being noticeable for nothing beyond steadiness. Nor have the electric railway issues varied to any extent. Central London Ordinary rose 1 to 94, and Waterloo and City stock has been supported at 95½. Metropolitan Consolidated is weak at 90 upon dividend considerations and fears of competition, while Districts lost a trifle at 38, due more to the position of the account in the stock than to considerations of the various Tube Bills down for Parliamentary powers in the next session. Another 2 per cent. rise lifted City and South London stock to 47, and the company's traffics are regarded as encouraging. Great Northern, Piccadilly and Brompton Fours are a shade firmer at 98¼, which is equal to 1¼ premium upon the original price of issue.

Electricity Supply shares have steadied after their pronounced fit of flatness. The market is still nervous and touchy; a few shares have again been put down in price, but in less wholesale style than was the case a week ago. County of Londons, Metropolitans, Westminsters, St. James's Preference and South London Electric have all lost ¼, while there is a 10s. loss in Charing Cross Ordinary and ⅛ in Metropolitan Preference. A Stock Exchange reader, who observed the list of prices and yields upon Preference shares of various Supply companies given here recently, has asked why the same treatment should not be accorded to the Ordinary shares. This is our excuse for the annexed table, where the figures are worked out upon the basis of the last two dividends, and the quotations taken at the middle level of those given in the two following pages and in the Stock Exchange Official List:—

Company.	Nominal value of share.	Price.	Last two dividends.	Yield per cent.	Dividends due.
Brompton & Kensington ..	5	9½	5/6—4/6	£5 5 3	Mar.—Aug.
Charing Cross	5	6⅞	4/-—2/6	£5 0 0	Feb.—Aug.
Chelsea	5	6	3/9—2/3	£5 0 0	Mar.—Sep.
City of London	10	12	7/-—5/-	£5 0 0	Feb.—July
County of London	10	9½	5/-—4/-	£4 14 9	Feb.—Aug.
Edmundson's	5	5½	2/6—4/6	£6 7 3	Jan.—July
Kensington	5	11¼	7/-—5/-	£5 6 8	Feb.—Aug.
Metropolitan	5	10	10⅝	£5 0 0	Mar.—Oct.
Notting Hill	10	15	8/-—6/-	£4 13 4	June—Dec.
St. James'	5	13½	9/6—5/-	£5 7 5	Feb.—Aug.
Urban	5	4½	2/6—2/6	£5 11 1	Apr.—Oct.
Westminster	5	12	7/6—6/6	£5 16 8	Feb.—Sep.

The above shares are Ordinary in each case, and so, of course, liable to fluctuating dividends. Some of the companies are uniting in order to obtain powers for fighting outside power schemes, by the formation of an undertaking under their own auspices.

Manufacturing varieties call for mention of brief character. Cromptons are 2, which is ⅛ better, and Brush Preference at 1¾ have risen ¼, although Electric Construction eased off to the tune of 2s. 6d. South Wales Power shares are a very dull market, the nominal price being 7½, with sellers predominant. Underwriting is proceeding for an issue of 140,000 6 per cent. cumulative Preferance shares of £1 each in the West Cumberland Power and Tramway Co., Ltd.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.§	Closing Quotations Nov. 22nd.	Closing Quotations Nov. 29th.	Business done week ended Nov. 29th, 1905. Highest	Lowest.	Rise + or Fall —
34,800	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	..	99 —102	99—102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	4 — 4¼	3¾— 4¼	..	..	− ¼
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	..	85 — 90	85 — 90	87¾	86½	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	23/8½	29s.§	62 — 64	62 — 64	..	..	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	58s.§	109¼—110½	109¼—110½	110⅝	109½	..
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	..	17⅝— 17¾	17¼ — 17⅜	17⅛	17⅛	− ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	102 —104	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7¼— 7⅞	7⅛— 7¼	7⅜	7 1/16	+ ⅛
1,932,856£	Commercial Cable Sting. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	..	96 — 98	96 — 98	97½	96½	..
16,000	Cuba Telegraph	10	6¾%	10 %	5 %	5 %§	8½ — 9¼	8½ — 9¼	9⅛	8¼	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %§	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %§	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %§	9¼ — 9⅝	9¼ — 9⅝	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%§	100 —103 %	100 —103	..	..	..
60,710£	Direct United States Cable	20	3¾%	3 %	3¾%	3 %§	13¼ — 13⅝	13⅜— 13⅝	13¾	13 7/16	..
74,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	..	100 —102	100⅜—102½	..	..	+ ½
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 %§	144 —147	144 —147	146½	144½	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%§	89 — 91	89¼ — 91½	90⅝	90⅛	+ ½
1,886,814	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	106 —108	106 —108	107	106	..
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	14½— 15	14½— 15	14 13/16	14⅝	..
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	106 —108	106 —108	106¼	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	..	99 —101	99½—101½	..	..	+ ½
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	99½—101½	100 —102	..	..	+1
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	..	10¼ — 10⅜	10¼ — 10⅜	10⅜	10¼	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	14⅜ — 14⅝	14¼ — 14⅜	14 1/16	14⅛	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	35 — 36	35 — 36	36	..	..
46,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	..	100 —102	100½—102½	..	..	+ ½
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	..	57 — 59	57½— 59½	59	58½	+ ½
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1 1/16 — 1 1/16	1⅛— 1⅛	..	..	− 1/16
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3 %	3 %	4 %	..	1⅛— 1⅛	1⅛— 1⅛	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	..	..	..	..	1 — 1	1 — 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %§	111 —112	111 —112	111⅞	109¾	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %§	107 —109	108 —110	108⅞	107½	+1
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %§	13 — 15	13 — 15	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %§	12 — 13	11 — 13	..	..	−1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %§	5⅝— 5⅞	5⅝— 5⅞	5¾	5 1/16	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	..	97½ — 99½	97½ — 99½	99	98	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	104 —106	104 —106	..	..	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	6 %	1½ — 1⅝	1½ — 1⅝	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	..	100 —103	100 —103	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %§	7¾— 8¼	7¾— 8	..	..	− ¼
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	..	102 —105	102 —105	..	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	125 —128	125—128	..	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7 — 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	6⅝— 6⅞	6⅝— 6⅞	5 7/16	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	..	110 —112	110 —112	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	10 — 10¾	10 — 10¾	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	1/16 — 1/16	1/16 — 1/16	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	100 —102	100 —102	100¼	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	14 — 14½	14 — 14½	14 1/16	..	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	..	102 —104	102 —104	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	103 —105	103 —105	104⅛	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	¼— ¾	¼— ¾	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	..	8½ — 9	8½ — 9	8⅛	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6½ — 7½	6½ — 7½	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	..	101 —104	101 —104	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

850,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	6 %§	8⅝— 8⅞	8⅛— 8¼	8⅜	8⅛	− ⅛
1,300,035	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅞— 6⅛	5⅞— 6⅛	5 13/16	5 11/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	142 —145	142 —145	..	..	..
200,000	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
530,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	16 %‖	3¾— 4	3¾— 4	3⅞	3 13/16	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	..	5 — 5⅛	5 — 5⅛	5 1/16	5 1/16	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	..	4⅜— 5⅛	4⅜— 5⅛	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅞— 3⅛	2⅞— 3⅛	..	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	98 —102	98 —102	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	124 —127	124 —127	125¼	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	113 —116	113 —116	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	106 —109	106 —109	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105 %	103 —105%	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	9⅞— 10⅛	9⅞— 10⅛	10 1/16	9 15/16	..
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	11 — 11⅛	11 — 11⅛	11⅛	11 1/16	..
1,000,000£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	121 —123	121 —123	..	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	..	98 — 100	98 —100	98⅛	98¼	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %§	6⅞— 7⅛	6⅞— 7⅛	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %§	5⅞— 6⅛	5⅞— 6⅛	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%§	103 —106	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	98 —100	98 —100	..	..	..
2,000,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	2 — 2⅜	2 — 2⅜	2 1/16	2¼	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	85 — 89	85 — 89	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	½— ¾	½— ¾	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1½— 1⅝	1½— 2	..	..	+ ⅛
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	..	93 — 97	93 — 97	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	..	77 — 80	78 — 81	80½	..	+1
500,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	..	3¼— 3⅜	3¼— 4	3½	3¼	+ ⅛
200,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	..	5 1/16 — 5 3/16	5 1/16 — 5 3/16	5 1/16	5⅛	..
137,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	..	5 — 5⅛	5 — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	107 —109	107 —109	108½	107½	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
525,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 %§	9½— 9⅝	9½— 9⅝	9 1/16	..	..
163,050	Do. 105,001to 137,610	5	..	..	..	3d.	8½— 9	8½— 9	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	107 —109	107 —109	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	11 — 12	11 — 12	11⅛	11⅜	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞— 6⅛	5⅞— 6⅛	5 11/16	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	109 —111	109 —111	109	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅞— 1⅛	⅞— 1⅛	1 1/16	31/32	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1 — 1⅛xd	1 — 1⅛	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,963,208	Central London Railway, Ord. Stock ..	Stock	4 %	4 %	4 %	4 %§	92 — 94	93 — 95	94⅛	94	+1
523,396	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %§	101 —103	101 —103	103	102	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	85 — 88	85 — 88	87⅞	86⅞	..
1,330,000	City and South London Railway	Stock	3½%	2⅜%	2½%	2 %§	44 — 46	46 — 48	46¼	45	+2
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	..	1⅝— 2	1⅝— 2⅛	2	..	+ ⅛
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	94 — 99	94 — 99⅝	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	§1905.	Closing Quotations Nov. 22nd.	Closing Quotations Nov. 29th.	Business done week ended Nov. 29th, 1905. Highest	Lowest.	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 52,000	† 5	..	..	10 %	..	8½— 9	8½— 9	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 61,000	5	..	6 %	6 %	6 %	5⅞— 6⅛	5⅞— 6⅛	6⅛	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	..	..	..
600,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	3 %	13¼— 14½	13¼— 14½	..	..	..
599,700	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14½— 15½	14½— 15½	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	..	99½—100½	99½—100½	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	..	98 — 99	98 — 99	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	..	96½— 97½	96 — 97	..	..	— ½
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1⅞— 1⅝	1⅞— 1⅝	1⅞	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%§	..	2 — 2⅛	2 — 2⅛	..	..	..
344,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	85 — 90	85 — 90	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	92 — 97	92 — 97	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅝— ¾	1— ⅛	..	..	— ⅛
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1⅞— 2⅛	1⅞— 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	..	92 — 95	92 — 95	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9½— 10	9½— 10	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	..	96 —100	96 —100	..	..	..
780,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %§	5⅛— 5⅜	5 — 5⅛	5⅛	5⅛	— ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10⅞— 11¼	10⅞— 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —102	102 —104	..	..	+1½
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	10%§	12⅛— 13⅛	12⅛— 13⅛	12⅜	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5⅛— 5⅜	5⅛— 5⅜	..	..	..
45,300	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	..	109 —111	.. ..	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10 %	5 %	2½%§	16 — 17	16 — 17	16⅜	..	..
800,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅜%	1½%	..	2⅛— 2⅜	1⅞— 2⅛	..	..	— ⅛
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	4 %§	10 — 11	10 — 11	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	4 %§	4 — 5	4 — 5	..	..	..
1,125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	10 — 10⅛	10 — 10⅛	10⅛	10⅛	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	100 — 130	100 —103	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	..	..	..	..	7/32— 9/32	7/32— 9/32	..	..	..
500,000	Do. 5 % Cum. Pref.	1	..	..	..	..	1— 1⅛	1— 1⅛	..	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	..	..	106—108	106 —108	106¾	..	..
100,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4⅞— 5⅛	4⅞— 5⅛	..	..	..
240,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	..	8¾— 9⅛	8¾— 9⅛	..	..	..
240,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9⅛— 9⅜	9⅛— 10	..	..	+ ⅛
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	..	101 — 104 xd	101 —104	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	..	32 — 34	32 — 34	32½	32¼	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	..	102 —104	102 —104	102¼	..	— ⅛
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	99½—100½	99 —100	..	..	..
640,000	Waterloo & City Railway, Ord. Stock	100	3⅛%	3⅛%	3⅛%	3 %§	94 — 97	94 — 97	96	94	..
333,330	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	..	6 %§	..	..	1½— 2	1½— 2	..	..	..
333,330	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	3 %	..	..	2½— 3½	2½— 3½	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	..	85 — 90	85 — 90	..	..	..

ELECTRICITY SUPPLY COMPANIES.

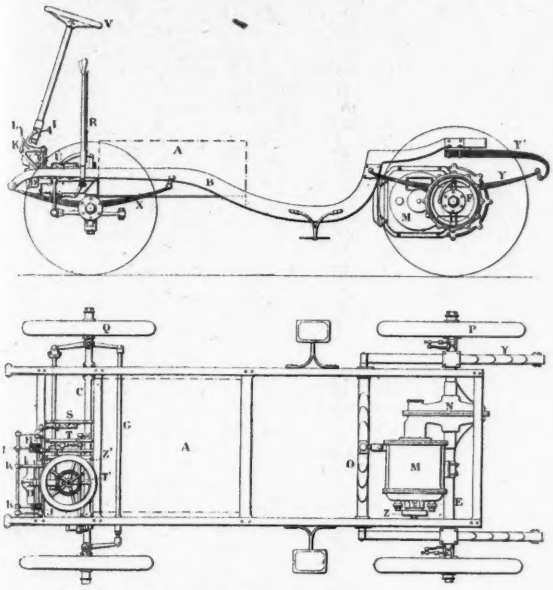
70,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 %§	5½— 5⅝	5½— 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	..	9¼— 9⅜	9¼— 9⅜	9⅜	9¼	..
29 623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	9 — 9⅛	9 — 9⅛	..	..	..
10·782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	..	105 —108	104 —107	..	..	—1
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %§	6⅞— 7⅛	6 — 7	6⅛	6⅛	— ⅛
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	5⅜— 5⅝	5⅛— 5⅝	5⅝	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	4⅜— 5	4⅜— 5	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	..	4⅜— 5	4⅜— 5	..	..	..
350,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	103 —105	103 —105	104⅜	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	4½%§	5⅞— 6⅛	5⅞— 6⅛	6⅛	..	..
150,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%§	110 —112	110 —112	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	..	11⅜— 12½	11⅜— 12½	11⅝	11⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	13½— 14½	13½— 14½	13⅝	13½	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	..	124 —128	124 —128	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	..	104 —106	104 —106	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	..	..	..	..	2⅛— 2⅜	.. — ..	2⅜	2⅜	..
50,000	Do. do. do. 5 % Pref.	5	..	..	..	..	5⅛— 5⅜	.. — ..	5⅛	5⅛	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	4 %§	9⅜— 10	9⅛— 9⅜	..	..	— ⅛
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	12⅜— 12⅞	12⅜— 12⅝	..	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	..	111 —114	112 —115	113½	113	+1
250,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	..	102 —104	102 —104	..	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	..	5⅝— 6⅛	5⅝— 6⅛	6⅛	..	..
300,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	..	108 —110	108 —110	..	..	..
50,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	4 %§	5⅛— 5⅜	5⅛— 5⅜	..	..	..
50,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
50,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
65,000	Hove, 1 to 13,000	5	..	8½%	8½%	..	8⅛— 8⅜	8 — 8⅛	..	..	— ⅛
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	..	5⅜— 6	5⅛— 6	..	..	..
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12 %	..	10⅞— 11⅛	10⅞— 11⅛	..	..	..
136,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	..	1⅞— 2⅛	1⅞— 2⅛	2⅛	2	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅞— 5⅛	4⅞— 5⅛	..	..	..
371,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	100⅜	100⅛	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8⅜%	10 %	10%§	10 — 10⅛	9⅞— 10⅛	10⅛	10⅛	— ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	..	5⅜— 5⅝	5⅜— 5⅝	5⅝	..	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	..	109 —113	109 —113	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	..	97 — 99	97 — 99	98⅛	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	..	101 —103	101 —103⅝	102¼	101⅞	..
285,045	Newcastle-on-Tyne, 1 to 57,009	5	..	8 %	8 %	2½%§	8 — 8¼	8 — 8⅛	..	..	..
89,955	Do. 57,010 to 75,000	5	..	..	..	2½%	8 — 8¼	8 — 8¼	..	..	..
285,045	Do. 5 % Pref., 1 to 57,009	5	..	5%	5	5 %	6⅛— 6⅜	6⅛— 6⅜	..	..	..
89,955	Do. 57,010 to 75,000	5	..	..	..	2½%	6⅛— 6⅜	6⅛— 6⅜	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	..	14⅜— 15⅜	14⅜— 15⅜	..	..	..
59,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	..	98 —100	98 —100	..	..	..
92,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	5 %§	6⅜— 6⅝	6⅜— 6⅝	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	100 —102	100 —102	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	10%§	13 — 14	13 — 14	13⅜	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %§	8¼— 9⅛	8 — 9	..	..	— ⅛
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	..	98 —100	98 —100	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	..	2 — 2⅛	2 — 2⅛	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	3 %	4 %	..	3⅛— 3⅜	3⅛— 3⅜	..	..	— ⅛
100,000	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	..	⅛— ⅜	⅛— ⅜	..	..	..
50,000	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	..	1⅛— 1⅛	1⅛— 1⅛	..	..	..
100,000	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	..	105 —108	105 —108	..	..	..
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	4⅛— 4⅜	4⅛— 4⅜	4⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	..	104 —106	104 —106	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13⅜%	14 %	13%§	12 — 12⅛	11⅞ —12⅛ x rts	12⅜	12	..
28,151	Do do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	6 — 6⅛	6 — 6⅛ x rts	6⅛	..	..

Shares not officially quoted :—Mackay Companies, ord., 54½—55½. Pref. 75—76.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th, 1905).

THE VEDRINE ELECTRICAL CARRIAGE.

We illustrate herewith a new electrical carriage which has recently been brought out in France by La Société des Voitures Electriques Vedrine (59, Boulevard du Chateau), Neuilly-sur-Seine. The frame, which is of pressed steel construction, is of special form, being curved downwards in the centre in order to permit a relatively low carriage body to be fitted. Particular attention has been paid



A, Battery of accumulators; B, Frame; C, Front axle; D, Steering gear; E, Rear axle; F, Rear wheel brakes; G, Steering bar; H, Starting pedal; I, Reversing pedal; J, Brake pedal; M, Motor; N, Enclosed spur gearing and differential gear; O, Transverse spring; P, Rear wheels; R, Hand brake lever; X, Front springs; Y, Rear springs; Z, Brake on motor spindle.

Figs. 1 & 2.—Elevation and Plan of Vedrine Electrical Carriage.

to the suspension, a transverse spring being provided at the rear, in addition to the usual longitudinal springs. The electrical energy is furnished by a battery of accumulators carried in a receptacle, A, under the driver's seat. Only one electric motor is employed, Messrs. Vedrine considering that one motor of fairly large power is more efficient than two small ones, the number of brushes and electrical connections being at the same time reduced. The motor, which is of the reversible type, is entirely enclosed and thus protected from dust and dirt; it is supported from the transverse spring and from the rear axle sleeve. The power is transmitted to the rear live axle through enclosed spur gearing. Another feature of the Vedrine vehicle is, that no controller in the usual sense of the term is employed. Ordinarily, in electrical vehicles, the speed is controlled by coupling up the batteries and motors in various ways. Messrs. Vedrine, in their cars, rely entirely on the variation of the magnetic field of the motor for the variation in speed. The speed

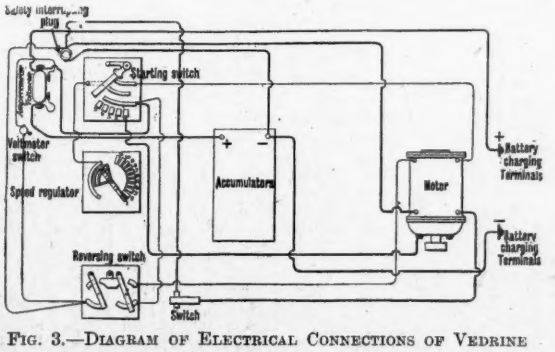


Fig. 3.—Diagram of Electrical Connections of Vedrine Carriage.

range of the motor is from 500 to 1,600 r.p.m., equal to from 4½ miles to 15 miles per hour. The driver has three pedals at his feet—one is for starting purposes, another for reversing, and the third for the application of the brake, its operation also cutting off the current. Once the car is in motion, the speed is entirely controlled by a small lever on the top of the steering wheel, in this respect following the practice adopted on modern petrol cars. In August last a Vedrine four-seated coupé was submitted to a long-distance trial. The vehicle weighed, complete, 1,800 kilogs, of which 550 kilo. was represented by a battery of Agathos accumulators of 210 ampere-hour capacity. The vehicle ran from Paris to Evreux, 62½ miles, without a stop. Here the battery was recharged in 2 hours 45 minutes, the journey being afterwards continued to Trouville, the average speed working out at 16·8 miles per hour.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

The Question of New Commercial Treaties.

The recent dispute in the Berlin electrical industry, which was detailed in this journal on October 13th, continues to form the subject of discussion among employers and workmen. It is asserted that the former will shortly publish a pamphlet giving the history of the strike and setting forth the reasons for their attitude on the wages question. The tactics of the Metal Workers' Union, which first caused a small number of men to leave their employment, are severely criticised by certain trade union organs.

The Association for the protection of the economic interests of the German electrical industry have presented memorials to the Government expressing the wishes of this industry in regard to the conclusion of new treaties of commerce with Spain, Portugal, Sweden, and the United States. Emphasis is laid upon the importance of the specific fixing of foreign duties as, in the opinion of the Association, the past decade has shown that foreign financial authorities devote their chief attention to electrical manufactures as objects for the imposition of duties, and that they soon endeavour to levy increasing duties upon them. This is shown in the Scandinavian countries and also in Italy, where shortly after the conclusion of the new commercial treaty with Germany the undefined duty on carbons was tripled, while that on porcelain articles has now been more than doubled. It is feared that this will also be the case in Belgium, where the most important duties for the electrical industry have not been fixed in the new treaty. In these circumstances the Association consider that the blessings of commercial treaties are illusory. It is further pointed out that bulk production in the United States, and the low transport rates, enable the American works to offer the strongest competition to their German rivals in the markets of South America, whereas the prohibitive duties in the United States completely exclude German competition from that country.

German Companies.

The directors of the Allgemeine Elektricitäts Gesellschaft are able to intimate more favourable results for the past year than those obtained in 1903-4. On the establishment of the company in 1883, the share capital only amounted to £250,000; in 1887 it was increased to £600,000, and it has gradually been advanced until it totals £4,300,000, while at the forthcoming meeting a proposal will be submitted for making a fresh issue of £700,000, so as to bring the ordinary share capital up to £5,000,000, apart from the bonds which exceed £1,400,000. After deducting working expenses, taxes and interest on bonds, and providing £60,107 for ordinary depreciation, the accounts for the past two years ended June 30th are as follows:—

	1904-5	1903-4.
Share capital	£4,300,000	£4,300,000
Net profits	£547,733	£428,331
Dividend, per cent.	10	9

After the payment of the higher rate of dividend, it is proposed to appropriate the sum of £50,000 out of the remaining profits for the depreciation of the new business premises in course of erection. The fresh capital of £700,000 is intended to provide additional working funds, and as the emission will take place at a considerable premium in view of the present quotation for the existing shares, it is probable that the new issue will realise about £1,250,000. The company is in negotiation with the Buda-Pesth firm of Ganz & Co., with the object of arriving at an agreement for the mutual limitation of markets. It is suggested that the German company should not compete for public contracts and large enterprises in Hungary, while the Hungarian firm is to abstain from similar rivalry in Austria and Germany.

The shareholders in the Rheydt Cable Works Co. (Kabelwerk Rheydt) have adopted the directors' report and accounts for 1904-5, and sanctioned an increase in the capital from £75,000 to £112,500. All the information given in the report, practically amounts to a statement that the course of business fulfilled expectations, and that remunerative employment is also hoped for in the future. The accounts showed net profits of £20,077, as compared with £17,717 in 1903-4, and a dividend has been declared at the rate of 15 per cent., as compared with 12 per cent. in the preceding 12 months. Apparently the new capital issue is largely intended to provide for extensions of buildings, machinery and equipment, of which a considerable portion has already been carried out.

The report for 1904-5 of the Telephon Fabrik Gesellschaft (late J. Berliner), of Hanover, states that the improvement in the general situation made further progress simultaneously with an increase in the volume of business, although the export trade was considerably less than in former years. The profits on manufacturing diminished owing, on the one hand, to the reduction in prices by competitors

without any cause, and, on the other, to advances in the prices of raw materials and in the rates of wages. With the balance from the preceding year, the net profits amount to £14,780, as compared with £14,237 in 1903-4, and a dividend of 9 per cent. is proposed to be paid, being the same rate as in the previous period. The share capital amounts to £150,000, of which £50,000 represents a recent increase, and the latter only participates in the dividend to the extent of one-half of the rate of distribution on the present occasion.

The recent general meeting of the shareholders in the Deutsche Kabelwerke, of Rummelsburg, near Berlin, approved the accounts for 1904-5 and the payment of a dividend at the rate of 5 per cent., as compared with 3 per cent. in the preceding year. Including the balance brought forward, the accounts showed net profits of £12,918, as against £9,474 in 1903-4, and after providing for depreciation and reserve funds, the dividend absorbed £5,000, leaving £688 to be carried to the current year. The directors' report stated that the turnover exhibited a further increase, which is attributed both to a greater demand for cables and an alteration in the conditions of the market. In explanation of the latter point, it is observed that the market for cables is now more open, in view of the growing transfer of electricity works from the possession of the promoters to the hands of the local authorities, as this renders it easier to secure larger orders which formerly devolved upon the originating companies without any competition taking place. In addition to this, the towns and communes are more and more having works built for themselves, with the result of benefiting the cable-makers. During the year competition was extremely keen and raw materials dear, while the prices of manufactures could only partly be advanced. The directors, however, hope by the perfection of the equipment for the working up of raw materials to find compensation for the rise in the prices charged for the latter. The company, which is interested in the Union Cable Co., Ltd., of London, reports the prevalence of slightly improved prices for the year now in progress.

The liquidators of the Helios Electricity Co., of Cologne-Ehrenfeld, the dissolution of which was decided upon last February, have issued a report for 1904-5 containing two balance-sheets, one being the liquidation balance-sheet to February 28th and the other referring to the end of the financial year, June 30th, 1905. As a final result the latter exhibits a deficiency of £389,000, as compared with a share capital of £419,500, most of which is represented by preference shares. The report states that manufacturing operations were mainly brought to a close at the end of August, that the branch offices and foreign technical bureaux have been entirely dissolved, and that the central stations and tramways still in progress are largely approaching completion. The Ehrenfeld works have been sold to the Cologne Industry Works Co. for £125,000, of which one-half has been paid, and the balance is due next January. It appears the latter company has been jointly formed by the Allgemeine Electricity Co., the Siemens & Halske Co. and the Lahmeyer Electricity Co., and the Ehrenfeld Works were taken over at the beginning of October, with the sole object of removing competition. The three proprietary companies do not intend to work the establishment on common account, but to dispose of it as a whole or in parts, and apparently in such a manner as to prevent it from again becoming a rival.

The gross profits of Garbe, Lahmeyer & Co., of Aix-la-Chapelle, amounted to £40,200 in 1904-5. After deducting the general expenses and providing for depreciation the net profits total £3,988, as compared with £179 in the previous year. The greater portion of the surplus has been placed to the reserve fund, and the balance carried forward. Thus the company has again been unable to pay any dividend. The directors report that the course of business is favourable at present.

The Electricity Co. (late Her. Poge), of Chemnitz, proposes to pay 5 per cent. for 1904-5, as compared with 4 per cent. in the previous year, but the Pfluger Accumulator Works Co. and the Gesellschaft fur Elektrische Industrie, of Carlsruhe, are both unable to make any distribution for the past financial year.

French and Other Works.

The gross revenue of the Compagnie Francaise des Cables Télégraphiques, as was shown in the report presented at the last meeting, amounted to 5,518,000 fr. in 1904, whereas the expenditure totalled 6,850,000 fr., thus leaving a deficiency of 1,332,000 fr. The latter was reduced to 532,000 fr. by the Government contribution of 800,000 fr. It was pointed out in the report that the year was still regulated by the terms of the Convention of 1901, as the supplementary Convention of 1903 was stopped in the commission on the Budget, although another was to be substituted for it. In these circumstances the report stated that it had not been possible for the company to undertake a financial reorganisation, or to improve the lines and working plant.

The Austrian Siemens-Schuckert Works Co., which is an amalgamation of the Austrian Schuckert Co. and the heavy electrical engineering departments of the Siemens & Halske Co. in that country, has declared a dividend at the rate of 2½ per cent. for 1904-5, which is the first complete year since the fusion took place at the beginning of 1904. According to the report submitted at the recent meeting, the net profits amounted to 473,970 kr., and after placing 23,698 kr. to the reserve fund and providing for the dividend on the paid-up capital of 18,000,000 kr., the balance has been carried forward. Having regard to the special costs incurred in completing the amalgamation of the two concerns, the directors considered the working results to be satisfactory, and it was stated that the orders on hand were materially greater than at the corresponding period of last year.

The report of the Vereinigte Elektricitäts-Gesellschaft (United Electricity Co.), of Vienna, which is a manufacturing concern also working two or three central stations, complains of the unfavourable economic conditions prevailing in 1904-5. The sale prices were exceedingly depressed, and failed to be sufficient to establish a remunerative relation between the cost of production and sales. Nevertheless, the turnover was increased, and 23,300 H.P. were delivered in the form of dynamos, motors and transformers, including the steam dynamos for the armoured cruisers *Georg* and *Karl* for the Austrian Navy. The scheme submitted for the ship-lifting plant on the Danube-Oder Canal near Prerau was recommended by the international jury for purchase by the Ministry of Commerce. Out of the net profit of 98,214 kr. realised in 1904-5, the sum of 20,000 kr. has been placed to the reserve fund, and the balance carried forward to the next account.

The accounts of the Russian Schuckert Co. for 1904-5 show net profits amounting to 149,537 roubles, as compared with a loss in the preceding year. After devoting 24,857 roubles to the purpose of depreciation, the balance has been disposed of by the extinction of the deficit of 95,000 roubles, and by the writing off of the remainder of the costs of establishment. The company, whose share capital is held by the Schuckert Co., of Nuremberg, has therefore again been unable to pay any dividend.

MUNICIPAL TRADING IN AMERICA: DISASTROUS RESULTS OF ELECTRIC LIGHTING.

[COMMUNICATED.]

The agitation which is being carried on in the United States for the municipalisation of public utilities has caused the *Terre Haute Mornigg Star* (Indiana) to collect data of the results attained by various cities which have carried on electric lighting and other undertakings. The data show unmistakably that many cities owned electric lighting plants which had proved disastrous failures, and had sooner or later been abandoned, or, if still carried on, the cost per lamp per annum is greater than would be the case if furnished by private companies. From the synopsis of a portion of the data published, it appears that of the 61 towns dealt with, 26 towns have abandoned municipal ownership, and have either disposed of their plant at a ruinous figure, sold it for junk, or have abandoned it altogether.

The provision of a sinking fund or depreciation fund does not appear to enter into the financial arrangements of many American cities. At Detroit, the plant cost in 1895 $650,000, and $175,000 have since been added to the investment account. The plant is insufficient and out of date, and as there is no money in hand to pay off the bonds on the original plant, the citizens are generally opposed to the expense of a new installation.

A committee which has reported on the Columbia City (Indiana) water and electric light undertakings, finds that the latter has been running into debt during the seven years it has been in operation. At Columbus (Ohio), the report of the committee which investigated the municipal lighting plant shows the cost of lamps to be $98 a year, but the city only pays $74.50 for lamps lit by private companies. The report covers a period of 4½ years, and the plant is abandoned as a "monstrous extravagance." It was said to be worth $68,000, but in December interest was being paid on $300,000 of bonds issued, so that the experiment has been rather a costly one for the ratepayers. An investment of $1,750,000 in electric lighting and water plant was made by Austin (Texas), an immense dam being built across the Colorado River. Shortly after the plant started the dam began to leak, and finally burst, destroying not only the entire plant, but causing a loss of over $3,000,000 to property in the city. Before the municipal plant was established, the tax rate was 90 cents on $100, but it is now $2.30.

The electrical light experiment at Braintree (Mass.) has raised the tax levy $17.20 on $1,000 to $20.40, and at Needham (Mass.) from $12.60 to $17.

When the citizens of Hamilton (Ohio) were asked to undertake the supply of water, gas and electric light, they were assured that the plant would not cost over $50,000. They have invested $755,000 in the service, and the State examiner reports the plant a failure. The annual interest on the bonds takes 90 per cent. of the entire revenue of the city, and the citizens have to pay assessments to meet the city's liabilities.

About 10 years ago Toledo (Ohio) established a municipal gas plant and borrowed $1,500,000 for the purpose. Three years ago the plant was sold for $102,000, and the city is now defending a law suit brought against it by the purchasers to recover $27,000 of the purchase price, as 3½ miles of pipe which they paid for did not exist.

At Marquette (Michigan) a loss of nearly $75,000 has resulted from the electric light undertaking. At Elgin (Illinois) the plant which cost $255,000, was operated for 16 years and was abandoned after sustaining a loss of over $100,000.

The electric lighting plant at Crawfordsville (Indiana) was to cost $32,000, but actually amounted to $105,000. When the cost per lamp had increased to $116 per annum, the taxpayers demanded that the plant should be sold. Persistent efforts were made to find a purchaser, but no one would offer more than one-third of the amount which had been expended, and attempts to lease the plant were also unsuccessful.

At Cherubusco (Indiana) many influential citizens opposed a municipal electric light system, but they were defeated by the non-tax-

paying voters. The undertaking was a failure, and when the bonds became due there were no funds to pay them off. The plant was accordingly sold to a private company. At Mishawaka (Indiana) the plant was sold under similar circumstances. The results of municipal ownership at Webster City caused such an increase in taxation that the citizens came to the conclusion after 20 years of faithful experiment that the system could not be a success, and the city repudiated it by defeating every municipalisation candidate.

The shrewd citizens of the United States evidently believe in cutting their losses, even if the results are sometimes rather disastrous. At Xenia (Ohio) plant which cost $35,000, after 14 years' use, was sold to a private company for $2,500; at Gravesend, plant which cost $120,000 was operated for a few years and sold to a private company for $31,000, and at Bowling Green (Ohio), where the interest during ownership was always paid out of the taxes, the plant which cost $47,000 was sold after four years' operation for $12,000.

The superintendent of the Allegheny (Pennsylvania) undertaking, on which $416,200 have been expended, has notified that the plant is obsolete and dangerous to use, and that it would cost $100,000 to put it in proper condition; while at Lansing (Michigan), where the lamps cost $101.20 per annum, the Mayor has declared that the city is really engaged in wholesale larceny, and that they ought to get out of the business and charge the loss to an experiment fund.

This list of experiments in municipal trading in the United States is far from exhaustive, but it affords some interesting object lessons for the advocates of private enterprise. The wave of municipalisation which is just now passing over the States, as it has passed over before, has this year brought many distinguished Americans to Europe, and especially to England, to study the question. They have generally gone back with the settled conviction that this form of municipal socialism is far from being the success which it has been described by its supporters, and that the prevailing opinion in America has been based on false grounds. Their own experiments would seem to point to even more disastrous results.

PROCEEDINGS OF INSTITUTIONS.

INSTITUTION OF ELECTRICAL ENGINEERS.

Abstract of Inaugural Address delivered in London on November 9th by John Gavey, C.B., *President.*

The art of telegraphy, considered in its broadest sense as a means of conveying intelligence over distances beyond the reach of the human voice, may be classed under three different heads:—

1. The communication of a limited number of definite orders or items of information by certain prearranged arbitrary signals. Under this heading may be included railway signalling, lighthouse signals, fire alarms, and other kindred uses.

2. Communication of all classes of information by means of alphabets, either arbitrary or those in common use, including semaphore and flag-signalling, Morse and other signals, printing and writing telegraphs.

3. Communication by actual exchange of speech, the telephone.

Telegraphs for Special Requirements.

Under this heading, one of the most important of the applications of telegraphy is that of directing and controlling the movements of trains on railways. The introduction of electricity for the working of telegraphs was soon followed by the invention of electrical miniature signals or indicators, placed in railway cabins, from which the outdoor manual signals were worked in accord with the indications recorded electrically. By this means the range of the signals was extended so as to cover the whole length of a section, and this led to the practical introduction of the block system of working traffic. Successive improvements in the electrical apparatus have been introduced; and it is not too much to say that the safety and regularity with which the heavy railway traffic in this country is conducted is largely due to the work of the electrical engineer. Lately definite advances have been made in two directions in this field of applied electricity. In the first, complete electrical systems of actuating points and signals have been introduced, the apparatus providing interlocking gear and indicators, which give the signalman positive information as to the position of every point and signal. This method admits of working points and signals at distances far in excess of the manual system, and the heavy and cumbersome lines of levers that, under old methods, could in many cases only be worked by the full exertion of the signalman's strength, can now be replaced by miniature levers which only need intelligence to work them.

In another direction, automatic methods have been designed for working outdoor signals directly by the action of the train itself, its entry, continuance in and exit from a section, being faithfully followed by the appropriate movements of the semaphores.

Automatic signals appear to meet a definite want on certain classes of railway, although no doubt the day is far distant when the trained signalman will be dispensed with at complicated junctions and stations. It is not too much, however, to say that without the various methods of electrical control that have been devised, and which are in general use, it would be utterly impossible for the great railways of the world to carry one-half the traffic they are now dealing with daily with safety and dispatch. In this branch of electrical work steady progress is being made, and apart from the question of haulage, the extension of the methods of electrical control will probably be considerable in the immediate future.

Fire-alarm signals have within the last few years assumed a position of considerable importance, owing to the growth of great cities, the increasing height of commercial buildings, and the large quantities of combustible material necessarily stored in the great centres of population. Starting from a simple alarum which was merely the old fire-bell worked electrically, complete systems of fire-alarms and indicators have been devised, which, when actuated from any given point, give the appropriate signals at all the fire-stations concerned, and admit of a rapid concentration of the necessary fire plant at any given spot in an incredibly short space of time. America has been in the past, and probably still is, in the forefront in the matter of fire-alarms appliances, and in my recent visit to that country I witnessed one example of the alacrity with which fire-engines can be called to any given spot. We had been visiting a number of telephone exchanges in New York and neighbourhood, and were motoring down on the long avenues on Manhattan Island. As we passed one shop, I noticed that some children leaning out of a first-floor window had just set fire to the canvas sun-blind, which was burning over an area of half a square yard, so that it had only just been set alight. Before we had got out of sight of the burning blind, we were passed by a steam fire-engine, a fire-escape and a hose-reel.

Ordinary Telegraphs.

Telegraph statistics have been furnished on previous occasions in presidential addresses and in papers presented to the Institution, and it may not be amiss here to compare former figures with those now available.

First dealing with telegraphs for the use of railways in the United Kingdom, I am able, through the courtesy of the various companies, to submit a table which illustrates the growth since the year 1879, up to which date definite information was supplied in a paper read by the late Mr. E. Graves in May, 1880.

Comparison of Railway Telegraphs in 1879 and in 1904.

	1879.	1904.
Mileage of poles	14,889¼	19,484½
„ „ wire	62,009½	161,741¾
Number of telegraph instruments	13,128	19,978
„ „ telephone „	Nil.	27,980
„ „ block „	22,411	56,176
„ „ repeater or signal instruments	11,308	81,682

Turning to the question of ordinary commercial telegraphy, the following figures may prove interesting:—

Telegraphs and Telephones Provided by the British Post Office.

	March 31st, 1880.	March 31st, 1905.
Mileage telegraph poles, underground and cable	25,675	38,032
Mileage telephone poles, underground and cable	Nil	14,898
Mileage telegraph wire	114,242	338,120
„ telephone „	40	253,521
Number of telegraph instruments ...	12,754	33,267
„ telephone „ ...	61	48,118

The growth of the traffic was until recently proportioned to the growth of plant, and although the ordinary telegraph traffic has now been checked by the advent of the telephone, that young and lusty child threatening to monopolise the greater portion of the short-distance work in all countries where it has free play, still, for long distances the questions of cost and the physical limitations of the telephone will check the rivalry of the latter, and there appears to be but a small prospect of serious interference or serious competition between the two methods of communication after a certain critical distance is reached. It may be convenient at this point to refer to the general statistics relating to the plant in use for telegraphs and telephones in those countries from which returns are obtainable, and so far as I have been able to gather them, they were represented by the following figures, at the end of the year 1902:—

Telegraphs.

Mileage of Overhead and Underground Telegraph Wire.

Aerial.	Underground.	Total.	Instruments.
3,433,911	225,748	3,659,659	265,835

Telephones.

Mileage of Overhead and Underground Wire.

Aerial.	Underground.	Submarine.	Total.	Stations.
4,197,416	2,530,215	11,145	7,467,417	3,534,036

The statistics showing the growth of the telephone systems in the United States are perhaps the most remarkable. The following table repeats the figures given by Sir William Preece in a paper read before the Institution in 1894, and those which appear in the American Bureau of the Census report for 1902:—

	1893.	1902.
Mileage of wire	532,256	4,850,486
Telephones in use	276,360	2,315,297
Telephone subscribers ...	232,140	2,178,366
Number of talks	600,000,000	5,070,000,000
Capital at par	—	$348,031,058

The growth from the year 1902 to the present time has shown no signs of diminution, so that it is difficult even for the most skilled experts in the States, or those best acquainted with the general situation, to forecast the ultimate development.

As to the amount of capital expended on telegraphs and telephones, the full facts are not forthcoming, as so much of the plant has been provided by the various Governments which do not keep ordinary commercial capital accounts, but it certainly amounts to hundreds of millions of pounds sterling. A consideration of these facts, however, tends to show that whether in capital invested, in plant provided, in staff engaged, or in commercial activity, both the telegraph and its daughter the telephone show no signs of lagging behind the other branches of electrical engineering; and so far as the telephone is concerned, notwithstanding the progress it has made up to the present date, there is every reason to think that we have only seen the commencement of its development in the United Kingdom. Much of its future success depends, however, on the action of local authorities, who will have to show a more accommodating spirit than many of them have done in the past, unless they desire that the constituencies that they represent shall lag behind the remainder of the world in the enjoyment of the facilities for intercommunication that science has placed at their disposal. For these bodies to insist that all telephonic connections shall be laid underground without regard to the number of wires to be provided, to the capital cost involved, or to the fact that long telephone trunk lines must, in the present state of our knowledge, be provided by means of overhead wires, is to place an insuperable bar to the provision of a cheap and efficient service. In its own interest, and for the good of the service which it controls, a telephone administration will always place its wires underground where it is either possible to work its circuits satisfactorily or it is not absolutely uneconomical to do so, but for local authorities to insist on this method being followed in every case simply means either the stifling of the industry or its provision at a cost beyond the reach of the ordinary user. When a corporation has to provide the capital expenditure for public undertakings it takes good care to see that no waste of funds takes place, but when the cost has to be provided by others, there is a tendency to make demands that would not be considered in carrying out its own works, the authorities appearing to be oblivious of the fact that the expenditure must be ultimately met in some form by those whom they represent.

If we now consider the actual apparatus by means of which commercial telegraphy is effected, perhaps the most surprising fact that strikes the observer is the predominance of the use of the ordinary Morse code and Morse apparatus throughout the world. Where high-speed automatic Morse apparatus, however, is in use, the want of a means of automatic transcription which would save the labour and delay of manual transcription has long been felt, and extremely promising systems have been devised whereby the problem has been solved in two different ways. In one, which was recently illustrated in a paper read before the Institution, a perforated slip is used for transmission, as in the ordinary Wheatstone system, but instead of the signals being received in Morse characters at the far end, a second slip is perforated, the exact counterpart of the original; this is placed in an automatic typewriter which prints the message on ordinary type. Two different methods of applying this system are now under the consideration of the Post Office.

It is interesting to note how the practice in the ordinary telegraph service has materially benefited by the development of other branches of applied electricity. Thus for testing and localising faults, and in order to obtain control over the large mass of wires entering the principal offices in this country, these were formerly attached to screw terminals fixed in a test box, which was bulky and occupied much valuable space in a costly building. The practice in the Post Office now is to terminate these wires on telephone jacks, and to provide for connections for testing, crossings or other purposes by means of plugs and flexible cords, the modern arrangement only occupying one-third the space of the old type. Again, the extended introduction of secondary cells charged from lighting plant by means of motor-generators has resulted in the last few years in the abolition of about 150,000 primary cells in the Post Office service, this change leading to a proportionate saving of space, and to a great economy in generating energy and in up-keep. Again, the great extent of modern London necessitates a very considerable amount of local telegraphic traffic. The number of inter-Metropolitan messages, viz., those from one part of London to another, some time ago amounted to 18,000 per diem. These were all re-transmitted at the Central Office, for it was obviously impossible to provide direct connecting wires between every one of some 600 telegraph offices. The Post Office, therefore, determined to revert to the system of switching lines through to one another as required.

A special switching board based on telephonic lines was designed to meet telegraphic requirements, and a section providing for 138 lines was fitted up at the Central Telegraph Office and brought into use experimentally on November 13th, 1902. Now, any office connected to the switch, which wants to communicate with another similarly connected, merely calls the latter, and the switch clerk hearing the call simply joins the two lines through in the manner adopted for telephonic service.

The result has been so satisfactory that the whole of the Metropolitan circuits are now being treated in a similar manner, and this handling of 18,000 messages twice over each day is about to be entirely obviated.

In submarine cable work the same progress may be noted as in other branches of telegraphy. The growth in half a century is represented by the following figures:—

1852	... ...	87 nautical miles
1892	... ...	139,594 ,,
1902	... ...	212,894 ,,

and it goes on without interruption.

Types of submarine cable have in practice not been materially changed, with the one exception of the air spaced submarine cable, designed for telephone purposes by Mr. Willoughby Smith, one of which was laid by the Post Office between Nevin, in North Wales, and Newcastle, in Ireland, in the year 1892. The problem of devising submarine cables for long-distance telephones, is however, still to be solved. The longest telephone cable of the old Paris type was laid by the Post Office in the year 1902 for communication between London and Brussels. It is 47 knots in length, and this is about the practical limit of distance over which satisfactory telephonic speech is possible under existing conditions when allowance is made for the addition of the connecting land lines, and of the local subscribers' plant.

(To be concluded.)

Abstract of Address delivered by J. M. M. Munro, *Chairman, to the Glasgow Local Section, November 14th,* 1905.

The keynote of Mr. Munro's inaugural address was "Municipal Trading." First recalling his attempt, 25 years ago, to establish a telephone exchange in Glasgow, which was not met with favour, he proceeded to recount the principal arguments against municipal trading, to the number of fourteen. Ex-Lord Provost Chisholm had defined the limits of legitimate municipal trading approximately as follows:—A town ought not to undertake the supply of a commodity or convenience unless (1) such service would be beneficial to the citizens generally—not merely to a section of them; (2) the service partook of the nature of a monopoly; (3) the operations in connection with it involved structural interference with streets or other public property.

The Chairman then dealt with the career of the Corporation of Glasgow in electrical-municipal trading, as a typical example, commencing with the installation of electric fire alarms in 1877. There are now 239 public and 50 private street fire alarm boxes, and 34 May-Oatway installations, and an 80-ft. fire escape driven by a petrol-electric system is under construction. Time service used to be given, but was dropped; the question of renewing it is under consideration.

The Corporation telephone service was opened in 1901, and now has 10,231 subscribers. Mr. Munro hoped that if the Government would not extend the period of the telephone licence, it would pay such a price for the exchange as would prevent loss to the City. "If so, the citizens will have benefited by their venture." There were in April this year 25,224 names in the combined directories.

The electricity department was opened in 1893 with Waterloo Street station, followed by the Port Dundas and Eglinton Toll works, and the Kelvinside undertaking was absorbed in 1899; the generated output last year (including traction) was over 44 million units.

The tramways were taken over in 1894, and first electrically operated in 1898. There are now 700 cars and 150 miles of track, and last year 200 million passengers were carried. The plant installed for tramway purposes is rated at 21,800 B.H.P., and the electricity department had in May last plant of 19,993 KW., which is being supplemented with steam turbo-generators.

The total consumption of coal last year was 82,623 tons; the Gas Department consumed 680,235 tons, generating nearly 6,450 million cb. ft. The tramway load factor was 41 per cent., and that of the electricity department 18·3 per cent.; the coal consumed per "useful" unit in the former case was 4·1 lb., and in the latter 6·2. Mr. Munro calculated that in 1915 the electrical departments would consume 200,000 tons of coal, and the gas department 560,000 tons.

The Chairman then turned to the questions whether the production of electrical energy should be concentrated in the hands of one separate department; whether the generating stations should be outside the City proper; and whether the City ought to purchase a coalfield, and he discussed the conditions of working of such a department. He had been biased in favour of erecting generating plant on a coalfield owned by the Corporation, but had failed to convince himself that there would be financial benefit from removing the generating stations outside the City. He believed that the large power gas engine or gas turbine was sure to come into use, and referred to the question whether it would be better to transmit gas or electricity to the City. Refuse destructors, peat fuel, &c., were also touched upon.

PHYSICAL SOCIETY.

At the meeting held November 10th, 1905, Dr. C. Chree, F.R.S., Vice-President, in the chair, a paper on "The Question of Temperature and Efficiency of Thermal Radiation" was read by Mr. James Swinburne. It has long been known that various surfaces have different emissivities, and it is generally held that at a given temperature some bodies radiate a larger percentage of their total radiation in the form of light. This view is largely based on some experiments by Evans and Bottomley. Evans's experiments really show that if two filaments A and B of the same area, but of low and high emissivities respectively, are run to give the same light, the filament A of lower emissivity will give a higher efficiency, and it will give a still higher efficiency if run so as to use the same power as B. This is a natural consequence of the different emissivities, and does not at all show that A gives a higher efficiency at the same temperature as B. Prof. Bottomley's experiments are criticised on the ground that he used no photometer, and his reasoning attacked on the ground that he makes the same slip as Evans in confusing difference of emissivity with difference of efficiency at the

same temperature. It is urged that a body A, at the same temperature as B, cannot give out radiation corresponding to a higher temperature of B; for if it could, and A and B were enclosed in a perfectly reflecting space, A would heat B to a higher temperature than A. High efficiency or selective emissivity is always sought in polished, grey, or white surfaces like flashed filaments, platinum, and other metal wires and rare earths. If there were such a thing, it should be found not in white but in black bodies, as a body which is a specially good radiator of light when hot, should be black when cold. Lummer's curves of the distribution of energy for a "black body" and polished platinum are compared, and show somewhat higher efficiency for platinum; but the comparison is difficult. The behaviour of flashed lamps and incandescent gas-mantles is explained by the difference of emissivity, without any need for selective emissivities.

The Secretary read a letter from Dr. J. T. Bottomley, in which he stated that he could not see that Mr. Swinburne had made a single experiment in support of his proposition that "In the case of pure temperature-radiation, the light-efficiency is a function of the surface-temperature only." He failed to see that the author had worked out any logical proof of the proposition.

Prof. H. L. Callendar, with regard to the action of incandescent mantles, thought the author's theory was reasonable and satisfactory.

Mr. Maurice Solomon said he did not agree with Mr. Swinburne's contention that in the case of solids there was no such thing as selective emissivity, but that all bodies at the same temperature radiated light of the same efficiency. Selective emissivity existed in the case of incandescent vapours, and if it was consistent with the laws of thermodynamics in such a case, it could not be inconsistent in the case of an incandescent solid.

Prof. W. E. Ayrton referred to experiments which he had carried out, which tended to show that the temperature of a Bunsen flame was lowered by an incandescent mantle. He had also found that small pieces of mantle heated in a platinum boat to various temperatures just below the melting point of platinum never looked brighter than the platinum. If, however, a small hole was made in the bottom of the boat and coal-gas passed in, the mantle immediately became brilliant.

Mr. Swinburne, replying to Dr. Bottomley, said that his main argument was that he had not made experiments. In the investigation of a question such as that considered in the paper, it was possible to prove much by means of experiment, but it was also possble to attack the problem by thermodynamic reasoning.

Mr. T. H. Blakesley read a "Note on Constant-Deviation Prisms."

THE USE OF GAS FOR POWER AND HEATING.

By Ernest A. Dowson, A.M.I.M.E., M.J.I.E.

Abstract of paper read before the Birmingham Association of Mechanical Engineers, April 27th, 1905.

Comparing gas engines and steam engines, the author stated that gas engines were performing nearly all the services to which the steam engine had previously been applied, one of the causes to which this was attributed being that the efficiency of a modern gas engine is quite 30 per cent. as compared with 15 per cent. for a good steam engine. Another advantage of the gas engine is the saving of ground space, as well as fuel, water, and labour, while the fact that small gas engines are practically as efficient as large ones is of importance in this comparison. Another point in favour of gas engines is that there is no loss in transmission to some distance from the generator, as compared with the heavy loss in the case of steam.

After comparing the apparatus required in each system, and showing the advantages of the gas plant, it was stated that the efficiency of the latter had reached 90 per cent., while in steam boilers the average efficiency was about 70 per cent., and this was seldom reached in the smaller units.

To show the advantage of the gas plant in consumption of fuel, a comparison between gas and steam plants of 100 B.H.P. was made, in which the former would consume under 1 lb. of coal per B.H.P.-hour as against 3 lb. for compound non-condensing steam plant of the best type. As showing that in common practice steam plants usually consume more than this, reference was made to an investigation made by the Birmingham Corporation some years ago in which the actual figures ranged from 9·6 to 27·5 lb. per I.H.P.-hour, the average being as high as 18 lb.

Referring to stand-by losses, these for gas plants were said to average under 5 per cent. of the equivalent for steam boilers.

Further advantages claimed for gas plants were greater simplicity and reduction in accessories; absence from danger due to high-pressure boilers and mains; installation can be left in unskilled hands, and can be put to work at full power under shorter notice than steam, thus being able to cope with unforeseen "peaks" owing to fogs, &c.

Passing on to the question of fuel gas, the author briefly described the chief characteristics of coal gas, coke oven gas, air gas, water gas, and semi-water gas, which he described as a combination of the above gases, a typical volumetric analysis of Dowson semi-water gas being:—

Hydrogen	18·50 per cent.
Carbon monoxide	25·25 ,,
Marsh gas (CH_4)	2·00 ,,
Carbon dioxide...	5·25 ,,
Nitrogen...	49·00 ,,
	100·00 ,,

The heating value is about 160 B.TH.U. per cb. ft., and the inclusive cost per 1,000 cb. ft. from 1½d. to 2½d. The sectional diagram of a Dowson gas plant (fig. 1) clearly shows the working of the system.

Many installations put down over 20 years ago are said to be still doing good service, showing long working life. At the Birmingham Small Arms Co.'s Cycle Works, gas plant put down in 1897 has since been extended, and the old steam plant entirely displaced.

For gas engine purposes, the best fuel is either small anthracite peas or ordinary gas coke, but latterly something has been done in the way of using ordinary hard, non-caking, bituminous coals; but the removal of tar in this case necessitates more extensive cleaning apparatus, part of which requires power, and there is increased water consumption.

After detailing the difficulties to be overcome in using bituminous coal in power-gas producers, the author said that, provided one had sufficient scrubbers and washers, there was no obstacle to the use of such bituminous fuel, and instanced the large plants arranged by Dr. Mond, in which the by-products were recovered; even in this case that fuel had to be selected which had a fair percentage of nitrogen.

Coming to the suction producer, in which the engine is made to draw air through the generator and produce exactly the quantity of gas required, without the intervention of a gas-holder, reference was made to tests showing a working efficiency of 89 per cent., quoted by Mr. Dugald Clerk in his "James Forrest" lecture.

A sectional view of a Dowson suction gas plant is shown in fig. 2, which is fairly self-explanatory. As showing that the power of the engine when working on gas of its own suction is not less than when the pressure system is employed, the author stated that he had often changed the engine over from normal working under pressure to working by suction alone, without having to ease the load. The fuel consumption comes to about ·8 lb. of small anthracite per B.H.P.-hour, such as can be obtained in Birmingham at about 18s. per ton, the water required for gas-making and cooling does not exceed about 6 pints hourly per B.H.P., while for a 100-B.H.P. plant the amount of attendance required only comes to about 2 hours daily for one man. With regard to space occupied, this is roughly about half a sq. ft. for each B.H.P. of capacity.

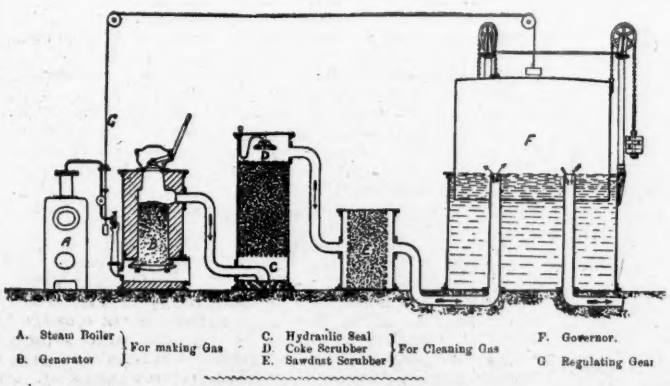


FIG. 1.—Section through DOWSON GAS PLANT. Injector Type.

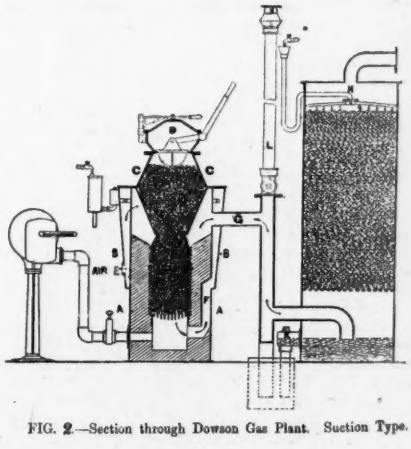


FIG. 2.—Section through Dowson Gas Plant. Suction Type.

In installations of this type, supplying current for electric light and power, the *whole station costs* were said to work out at ½d. to ⅝d. per unit.

(*To be concluded.*)

AN ELECTRICALLY-DRIVEN REFRIGERATING PLANT.

Through the courtesy of Messrs. Aplin & Barrett, Ltd., of Yeovil and London, we were recently enabled to inspect a modern cold storage plant which the firm have equipped at Battersea; the plant in question is utilised for the preservation and storage of perishable produce prior to its distribution to the firm's customers.

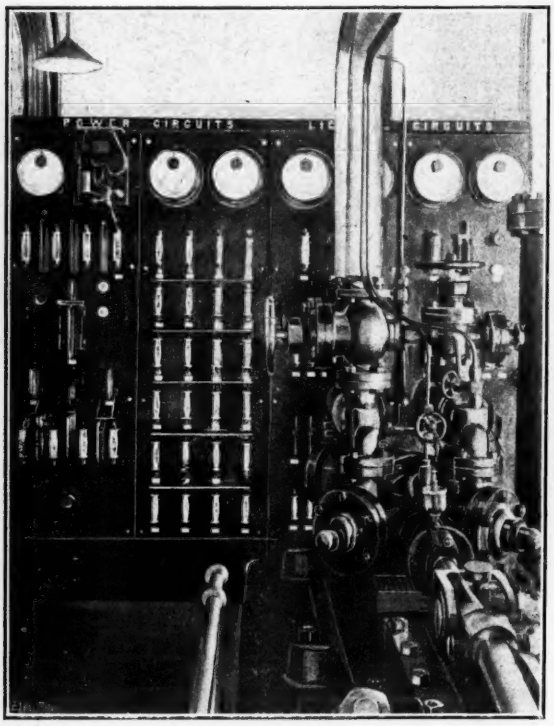


Fig. 1.—View of the Switchboard in the Compressor House.

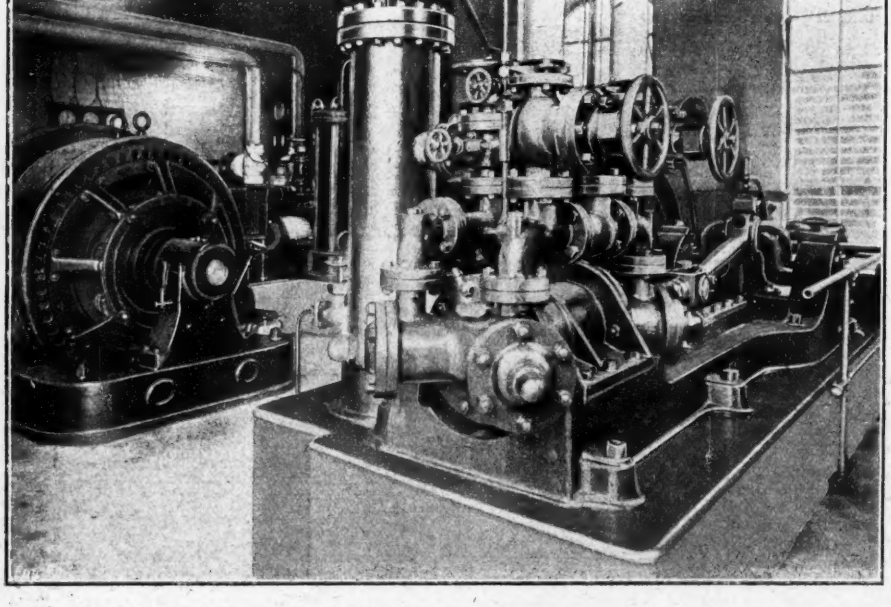


Fig. 2.—View in the Compressor House.

The interesting point about this plant lies in the fact that the ammonia compressors are electrically-driven by means of direct-coupled variable speed motors, an arrangement naturally tending to extreme compactness and easy manipulation in comparison with steam or gas-driven plants; and further, that electric driving and lighting has been adopted throughout.

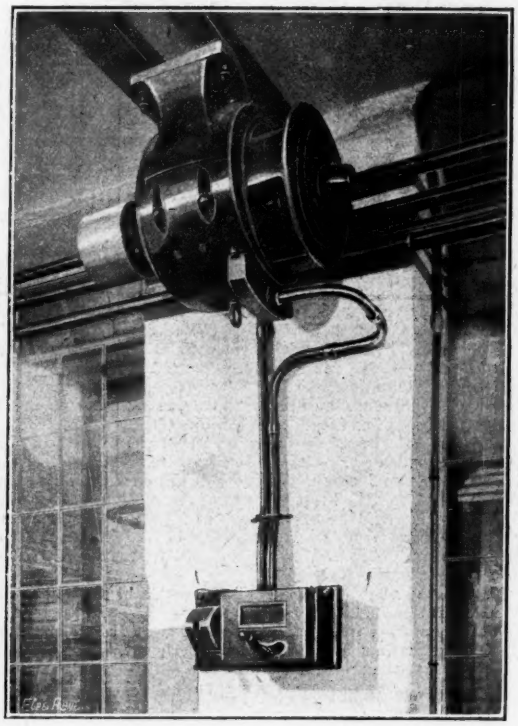


Fig. 3.—Standard Arrangement of Ceiling Motors with Switchgear.

Energy for operating the motors, and for lighting, is purchased from Battersea Electricity Department, the power and lighting mains (three-wire) being led into the compressor house adjacent to the main buildings, where the two supplies are metered and led to a main switchboard, fig. 1, which controls the whole of the electrical circuits in the buildings.

At present two cold storages are in use, each having a capacity of 22,000 cb. ft., the refrigeration in each case being obtained by cold air circulation in conjunction with an ammonia plant.

The refrigerating plant was supplied by the Haslam Foundry and Engineering Co., and consists of two compressors of the double-acting type, in which the anhydrous ammonia reaches its initial compression, subsequently being forced through a condenser of the evaporative type into a receiver. From the latter it is allowed to expand and vapourize through suitable expansion valves into duplicate pipes leading to two cooling batteries in the storage, the expansion, of course, coinciding with a big reduction in temperature of the ammonia. By means of fans the air is forced through the cooling batteries into the stores and sucked out again, through inward and outward ducts arranged on either side. The cooling batteries can be utilised either together or separately, and for either storage.

Each of the compressors is coupled direct to a compound-wound variable-speed motor, by Newton Bros., Derby, capable of giving

30 B.H.P. continuously at the higher speed, the speed variation being from 65 to 90 r.p.m., which is obtained by means of shunt regulation.

The Sturtevant starters and regulators are mounted on the motor frames as shown in fig. 4, and the heavy fly-wheel mounted on the shaft ensures an exceedingly steady drive.

The arrangement of the valves of each compressor enables one end of the cylinder to be worked on one of the cooling batteries and the other end on the second battery, thus making it possible to keep widely different temperatures if necessary in the two stores, with one compressor working.

The cooling batteries consist of galvanised corrugated iron plates, arranged in nests, with coils of lap-welded direct-expansion ammonia pipes, standing over a wrought-iron brine tank, and the whole enclosed by a non-conducting casing. Each cooler is fitted with a 30-in. Blackman fan for circulating air, the shafting which carries the fans being driven from the couplings of the brine pump motors.

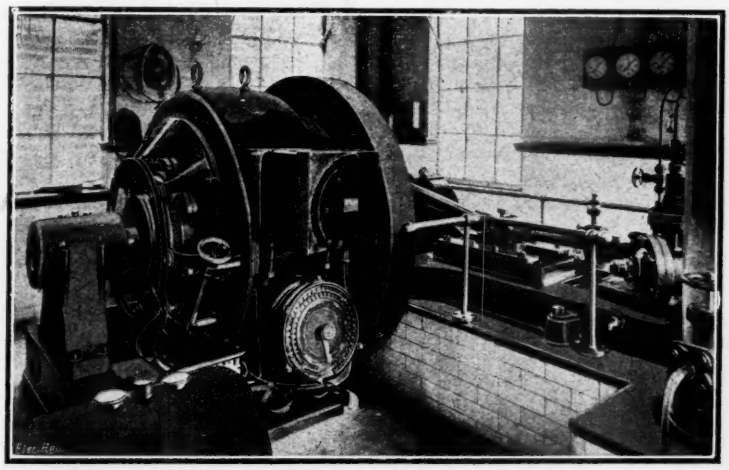


FIG. 4.—VIEW OF MOTOR DIRECT COUPLED TO COMPRESSOR, WITH STARTING SWITCHGEAR, &c.

There are two sets of brine pumps, each consisting of two 2-in. rotary pumps by Messrs. Gwynne & Co., and each coupled at either end to a 5-B.H.P. B.T.H. shunt-motor. By means of these pumps the brine is circulated over the ammonia coils and corrugated plates above referred to, the cooling effect being produced by the expansion of the ammonia in the coils of the battery. The ammonia condenser in the yard is of the evaporative type in three sections; each section is provided with independent valves and cocks, so that it may be shut off if desired.

The circulating water is pumped, either from the dock or the tank under the condenser, by means of a 2-in. Gwynne centrifugal pump coupled to a variable speed B.T.H. motor, situated in the compressor house.

As previously mentioned, the switchboard is situated in the compressor house; it contains two power panels controlled by a circuit breaker and fitted with positive and negative switch fuses for 16 motor circuits; also two panels for the various lighting circuits, in which also positive and negative isolating switches are fitted to each circuit.

The wiring throughout is in screwed steel conduit, the conductors in all cases being "pushed through."

At the ends of every length of conduit, suitable insulating bushes are employed in order to protect the insulation from rough edges. Several 10 and 4-H.P. motors are installed in the main building for operating individual machines; the larger motors are fixed to the ceilings with the starting and regulating switches on the wall below, as shown in fig. 3, the smaller ones being located under benches; and a 2-H.P. motor is used for operating a box elevator.

An electrically operated 1-ton lift, of Messrs. A. Smith & Stevens's make, communicates between the various floors; automatic safety devices are provided for holding the lift in case of breakage of either of the suspension ropes or of over-travel. The 10-H.P. motor for the latter, and, indeed, all the motors are operated on the 460-volt circuit.

For the lighting of the building, 250 incandescent and 15 B.T.H. 2½-ampere enclosed arc lamps are provided, the lighting circuits from the main board being led to ironclad distribution boxes, which control lighting groups. All the distribution boxes are directly earthed.

The lighting of the cold storage is by means of lamps in oyster fittings, each group of four being controlled by a switch. This method of lighting is an exceedingly convenient and suitable one for the situation, and it may be mentioned that the switches throughout the factory portion of the building are of the ironclad pattern.

Messrs. E. J. Eckersley & Co., of Manchester, were the contractors for the electric lighting installation and wiring generally.

The advantages of electric driving for such work as the above cannot be overestimated. Ice making and refrigerating plants are generally situated in built-up areas, where compactness, cleanliness and freedom from noise are invaluable features; as a matter of fact, the exceedingly compact nature of this compressor plant precluded our obtaining adequate illustrations of it. The use of direct-coupled variable speed motors in this connection is also, we believe, somewhat of a novelty.

The whole of the cold storage plant and electrical installation has been carried out to the specifications and under the supervision of Mr. Philip Dawe, A.M.I.C.E, of Westminster; the architect for the buildings was Mr. Edgar S. Underwood, of London, E.C.

THE ELECTRICAL FROISSART CHRONICLES.

(With some apologies to Sir John, and more to "F. C. G.") By Ibid.

No. III.—The Olympian Games.

I would not have you suppose that all the Electricks be sad fellows, grey with much study, and abstract with fervent ponderings. For to the Outer Circles it is permitted to have what they call a Sense of Humor, if so be that the possessor shall certify that he is takying steps to be healed of the same. And this Affection doth occasionally break forth amongst them, and evidence itself in the holding of Fayres or other variety of Benefest, though it is not permitted to be shown in their Conversazion. Of these is the Fayre which they have held in the great hall of Olympus, where divers gods have held sway in these later times. Now, whether this is a Fayre, or affair or function of the Guild, I am not precisely informed; but I have taken careful note of its appearance, and of the curious machines which therein are displayed, the better to decide.

Mark then, the hall is laid out as it were in streetes of boothes and fenced squares, and on these boothes are displayed all manner of magick, as far as a man may see; and to each booth or square several learned men, filled with a righteous zeal for informing those that resort there the meaning of the many signs and curious implements. And this will seem to you a very good undertaking, for thereby even the great and powerful, and the consultings (which, I am told, is a kind of electrick of a most comprehensive ignorance, which is kept and instructed at the expense of the rest because it hath the gift of eloquence) may come to know something of the reason for those things which they see at their clubbes and in the streetes, effected by the Electricks.

To tell of the many wonders that there are shown and explayned (and of those that are explayned and not shown) needeth a very grete deal of paper; moreover, many learned men have already recorded it. That which can be seen is that it is a marvellous fine show of lights and all instruments concerning the noble patrons of the Guild, whom they call consumer. But of these strange coaches which are caused to run on iron grooves by various means, either the upper or the lower (or penny-rate-in-the-slot) or the push-button, saw I nothing at all.

Now it is not always that the Electricks which are there have sufficient consumers before them to instruct, wherefore, to while the tedium of their wayting, various sports or games are given, as the opening, which is on this wise: They do lay out sundry odd boxes, wood, shavings, and the like, and, bringing thereto a number of men of greate repute in other matters, do cause them to travel at speed over and around the obstacles aforesaid; whensoever they pause for breath, it is recorded on a tablet the name of the nearest booth; and the owners thereof are mightily pleased; without this is never a Fayre held.

At other times they will fetch in from the unexplored regions of the North, and the forests of the Mid land, the chiefs of the tribes thereabout; and this can be done without danger, for theyre nature is not so wilde as is commonly reported. Now, these are of the gretest consumers, and it is theyre delight to provide themselves with the instruments most suited to the rugged country which they inhabit; saying, by the arc lighting of such a pass shall we confound the raiders of a neighbouring tribe; or, "an we com accross a bridge in a carriage of the Electricks we shall be the sooner over," which is a thing not rightly understood in Westminstere. Neither do they comprehend here that the grete mill grindeth cheper than many little mills; but these folke understand it.

Now, the case of these foreigners exciteth the compassion of the learned men who are at the boothes and enclosures aforesaid ; and they display a kind forwardness to explain to them the virtues of the contrivances displayed on their boothes. It is well to be seen that these learned men, wearing themselves in the study and perfecting each of his own machine, do become, as it were, greatly attached thereto ; wherefore they will say, "This is, without doubt, the best," and so many as are there shown the more the mind of the stranger becometh confounded. In such a case, what can he do? He will hie to the nearest of the laboratories that are round about, and there he findeth one of those Electricks which are called Consultings engaged in a kind of Alchemy. Then he consulteth : "I pray you, what is the shrewdest machine for the stewing of Indian herbs ?" (or for whatsoever purpose he requireth it). And the Consulting, privily reading a list which he hath on his tablets, counselleth "Such an one," being the name that first thereon appeareth. Whose this is receiveth the reward or prize of this game.

The power of these Consultings in thus awarding the prize is evident, and thereby is shown the esteem in which this people hold the art of eloquence, for I am assured that they have no other quality. Yet it seemeth strange that they should be of the whole Guild enriched and placated for this thing alone, seeing that in that land the preachers have but small fees, and the Parlements none at all, and these make more noise than any Electrick. Wherefore I am constrained to esteem these people as possessors of the Secret of the Guild, and members of the Inner Circle, which accounteth for the reverence and fear in which they are held.

THE SEPARATION OF IRON AND FRICTION LOSSES IN DIRECT CURRENT MACHINERY.

By F. HANDLEY PAGE.

From time to time various methods of determining the different losses in direct current machinery have been brought out and many modifications of these methods proposed, some special advantage being claimed for each one over preceding ones. With the advent of direct-current compensated motors, it has become extremely important, owing to the wide range of speed variation used, that a quick and easy method should be available for finding the iron and friction losses at different speeds of the motor. For this purpose, the two principal ones which have been used until now are the well-known "Swinburne" and "Hopkinson" tests.

In the "Swinburne test" the motor is run light at various excitations, and on correspondingly varying voltages, so as to keep the speed constant, and a curve plotted connecting watts input (after deducting all the C^2R losses) with excitation. This curve, when extended to zero excitation, gives the friction loss at the speed at which the motor was run. To obtain the friction loss-speed curve, it is necessary to carry out several of these tests at different speeds before one can obtain sufficient values of the friction loss. This method is, therefore, at once out of the question, on account of the length of time involved in taking the tests, although the results obtained by it are absolutely reliable.

For the second method under consideration—due to Kapp—two machines are needed, one to act as motor and drive the other which is under test. First, by running the motor light at different speeds, the total losses of the motor at the various speeds are obtained. Secondly, by running the motor driving the generator unexcited at different speeds, the total losses of the motor plus the friction loss of the generator are obtained, and by subtracting the watts input given by the first test from those given by the second at any required speed, the frictional loss at that speed is at once determined. To find the iron loss at the different speeds, it is necessary to take a third test with the generator excited from a constant excitation, and the increase in the watts input at any speed is equal to the iron loss in the generator at that speed.

This last method complies better with what is required, but, with the test carried out and the results calculated in the way indicated above, it is still a tedious process. This has led the writer to employ a slight modification of the above test, and this has given excellent results.

For this test, two machines of similar type, size and voltage, are coupled together, and the one run as a motor driving the second, which is unexcited. The speed of the motor is varied by altering the shunt excitation, and simultaneous readings are taken of the armature amperes and volts, the excitation and speed. The fields of the two machines are now put in series across double the normal voltage of one machine, and a second test carried out exactly similar to test No. 1, with the exception that the excitation now passes through the fields of the second machine as well as the first. From these tests two curves are plotted connecting watts lost (exclusive of C^2R losses) with r.p.m. In the first test, at any speed in r.p.m., the loss, w, is equal to the friction losses of the two machines plus the iron loss in the motor. In the second test there are the same losses as before plus the additional loss in the generator. Now, as the two machines are of the same size, type and voltage, the field in both will be approximately the same if the same exciting current is flowing through their field coils. This

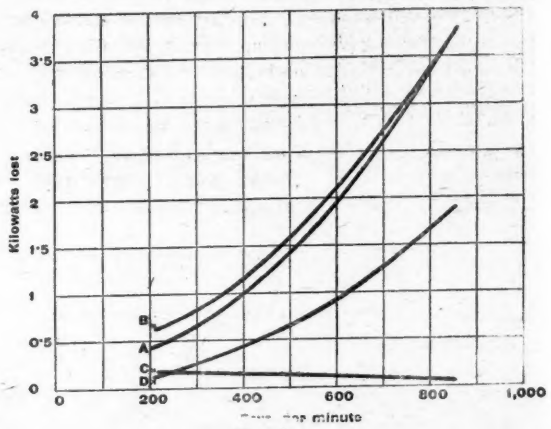


Fig. 1.

condition was fulfilled by putting the two fields in series, and consequently in the second test the increased loss is due to the iron loss being doubled. Subtracting the results obtained by the first test from those given by the second, we get the iron loss at any speed of the motor; and, further, subtracting the iron loss from the results obtained from No. 1 test, the friction losses of the two machines are determined. If this result be halved, the friction loss of one machine is at once obtained, and thus by two simple tests the whole separation is effected.

This result could have been accomplished with the first two tests of the Kapp method, for, by using two similar machines and subtracting the friction losses of the second machine from the no-load losses of the motor at its different speeds, the iron losses of the motor are obtained. This method will, however, very easily admit of serious errors, owing to differences in the friction losses of the two machines. This is especially the case when the motor is running at its higher speeds, for then the iron loss is small compared with the friction loss, and a small error in the latter will cause a large percentage error in the former.

In the first method, even the errors due to differences in the fields of the two machines, when both have the same exciting current, can be easily eliminated. It is only necessary, whilst taking the second curve, to place a voltmeter across the generator armature terminals, and to read the armature volts corresponding to the different excitations. The flux in the generator can then be calculated, and a curve plotted of iron loss against flux, instead of against r.p.m. By making a corresponding calculation for the motor, it will be at once ascertained whether the two fluxes are the same for any given excitation, and, if not, the true value of the motor iron loss can be found from the generator iron loss curve.

In fig. 1 are given curves showing the results of tests on a 30-H.P. motor made by the British Electric Plant Co., Ltd., of Alloa, Scotland. Curve A shows the total watts input (exclusive of C^2R loss in armature and field) of the motor when driving the unexcited generator. Curve B gives the watts input (after deducting the C^2R losses as before) in the motor when it is driving the generator with the same current passing through both generator and motor fields. Curve C is obtained by subtracting A from B at several different speeds, and gives the iron loss at any speed. Curve D gives the friction loss of one machine at different r.p.m., and is obtained by plotting half the difference of curves A and C against speed.

The writer's thanks are due to Dr. Breslauer, of the British Electric Plant Co., Ltd., for permission to publish the results obtained by this method.

USES OF ELECTRICITY IN MINES.

The Cantor lectures delivered by Mr. H. W. Ravenshaw on May 15th and 22nd, 1905, before the members of the Society of Arts, and printed in the September issue of the *Journal* of that body, are of special value to electrical engineers interested in the uses of electricity in mines.

Some idea of the various classes of machinery in general use about collieries, with the type of load and the range of sizes usually met with, is given in the following table:—

Purpose.	Usual sizes.	Type of load.
Winding	50 to 2,000 B.H.P.	Intermittent, with frequent short stops.
Single rope haulage	5 to 200 B.H.P.	Intermittent, with long stops.
Continuous haulage	15 to 500 B.H.P.	Steady.
Main and tail haulage	15 to 100 B.H.P.	Intermittent, with fairly long stops.
Locomotives ...	15 to 100 B.H.P.	Intermittent, with variable stops.
Coal cutters ...	20 to 50 B.H.P.	Intermittent, with variable stops.
Creepers	10 to 30 B.H.P.	Continuous variable.
Pumping	5 to 500 B.H.P.	Steady.
Air compressors ...	20 to 100 B.H.P.	Intermittent.
Fans...	20 to 200 B.H.P.	Steady.
Screens	20 to 50 B.H.P.	Steady.
Coal washing ...	20 to 100 B.H.P.	Fairly steady.
Stamps	15 to 100 B.H.P.	Steady.
Crushers	20 to 100 B.H.P.	Very variable.

Mr. Ravenshaw deals with most of the items in the above table separately. As to winding, he says:—"Steam engines are at present almost universally used for winding, many of them being of large size, and capable of raising heavy loads at a high speed. The character of the load requires rapid acceleration and retardation, with extreme accuracy of control. The importance of accurate control is shown in a diagram (see fig. 1). . . . where an engine raises nearly 5 tons of coal in 42 seconds from a depth of 544 yards. The load attains a speed of 45 miles an hour, and yet it only takes 12 seconds to bring it from full speed to rest. This is done 500 times a day all the year round with a remarkable freedom from accident." Then speaking of electric winding engines:—"Some electrically-driven winding engines have been erected on the Continent, and are giving satisfaction; a good many are also being erected in this country. For small pits and staples (shafts connecting one underground level with another) electrical winding engines have been in use for a good many years, and I know of one which was put down in 1891, and has been in use ever since. Owing to the large amount of power required, and the extreme variations of the demand, the large electrical winding engine presents one of the most difficult problems that the electrical engineer has to deal with."

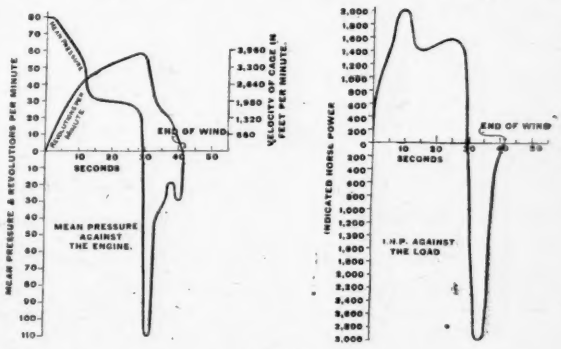
"The problem is that the engine has to start a heavy weight of, say, 5 tons, from rest, raise it 500 yards in 40 seconds, stop for 15 seconds, and repeat the operation in the reverse direction. This means that the engine must give an enormous starting effort, and develop from 1,500 to 2,000 H.P. for 30 seconds. It must also be capable of absorbing a large proportion of the energy that has been put into the load so as to enable an accurate stop to be made at the end of its travel. It must be remembered that the moving parts are of great weight, and move at a high velocity, thereby increasing the difficulties in acceleration and retardation. . . . . Where rapid and economical winding is necessary, it is important that the load should be as uniform as possible, and this requirement is not obtained when the cages are unbalanced."

Figs. 1 and 2, which we here reproduce, show the two systems of unbalanced and balanced ropes respectively. In the latter case the rope is balanced by a tail rope under the cages. With the former, again quoting Mr. Ravenshaw. "Owing to the great weight of the rope the load on the engine is constantly varying; for instance, the unbalanced load at starting is the weight of coal to be raised plus the weight of rope. When the cages are passing, the ropes balance each other, and the load unbalanced is equal to the coal being raised. Towards the end of the wind the weight of the descending rope predominates and actually overbalances the weight of coal. To give an instance in a particular case, the coal weighed three tons and the rope four tons. As a result, the load against the

Fig. 1.

Fig. 2.

engine at starting was seven tons, at the middle of the wind three tons, and at the end of the wind an overbalance of one ton was tending to drive the engine. This means an extremely variable load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END OF WIND.
SECONDS
VELOCITY OF CAGE IN FEET PER MINUTE.
INDICATED HORSE POWER
I.H.P. AGAINST THE LOAD

Fig. 3.

and a tendency to run away at the end of the wind." By using a balance rope, as shown in fig. 2, these objections are overcome, and "by the use of a heavy balance rope the stresses due to inertia can also be partly balanced. This method of balancing is frequently

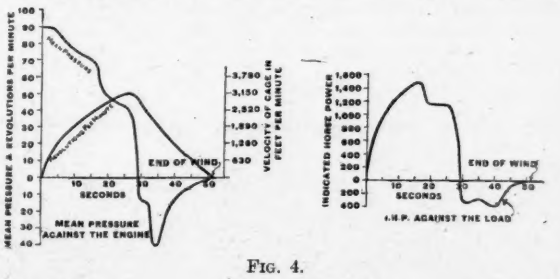
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Fig. 4.

used in this country, and it is doubtful if really fast winding can be economically carried out without this or some similar arrangement."

Without detracting in any way from what Mr. Ravenshaw has said, we may be allowed to point out that it is a mistake to assume that *fast* winding, whether balanced or unbalanced, is really economical. Theoretically, the balancing should be arranged to overcome the inertia due to the dead weight of the mass to be put in motion and accelerated, then to run in balance during the steady motion period, and overbalance in the same way as at the start, but negatively, to retard the moving masses. Further, it is more economical to wind a heavy load at a low speed than a light one at

a high rate of speed, and it can be shown that, for a given output in a stated period, the former will require a less engine than the latter.

In figs. 1 and 2 it is also to be noticed that two loading platforms are shown, but it is not to be understood that this is always the arrangement with multi-decked cages, though undoubtedly it is the best. More often there is only one loading platform, and each deck of the cage has to be changed separately by the engine-man. The cages are also rested upon catches or "keps" at the surface, and often at the pit bottom as well. Hence, unless "keps," which may be removed or withdrawn while the weight of the cage is still resting upon them are adopted, the cage has to be slightly raised by the engine to allow them to be withdrawn, when the engine is again reversed to lower the cage, so that two reversals of the engine take place with the changing up of each deck. We may refer our readers who wish to go more deeply into the subject, to "The Mechanical Engineering of Collieries," by T. Campbell Futers, published by the *Colliery Guardian* Co., where the question is fully discussed.

Mr. Ravenshaw has designed an apparatus for taking continuous records of the work done by winding engines, and the results of tests taken from two large steam winding engines of modern design under actual working conditions are shown graphically in figs. 3 and 4. The former shows "that with the balanced arrangement a much higher rate of acceleration is obtained, steam is on the pistons for two-thirds of the running time and the cages are very promptly brought to rest. In the unbalanced arrangement, although the maximum horse-power developed per ton of coal raised is greater, the speed of wind is less, the acceleration and retardation are less rapid, and steam is only applied to the pistons for one-half of the running time."

In neither case were the brakes used for retarding, and it is interesting to note the large amount of energy required to stop, especially in the case of the balanced load, where the mean pressure against the engine rises to 110 lb. per sq. in., a greater indicated horse-power, in fact, being developed to stop the load than to raise it. "The peculiar shape of the power curve is due to the fact that in each case when the engine attained a speed of about 40 r.p.m. an automatic cut-off came into play. . . . In fig. 3 steam was admitted during the whole of the stroke for six revolutions; it was cut off at one-fourth of the stroke for 14 revolutions, and the valves were reversed with steam against the load for five revolutions." The diagrams are both interesting and instructive, and show clearly the work at present being done by what are considered really "good" steam winding engines in this country. The problem of dynamic balancing is to turn the "negative" work below the zero line into "positive," and so reduce the extreme variation of the mean pressure line, which in an ideal winding engine would be almost a straight line parallel to the zero line.

With reference to electrical winding, the lecturer continues:—"Although these diagrams do not bear directly upon the question of electric driving, they are of the greatest importance as showing the kind of load that must be dealt with if rapid winding has to be carried out electrically. It will be seen that to apply electrical driving to so variable a load, presents considerable difficulties, and that if the demand on the supply is to be free from sudden fluctuations, some method must be adopted for storing up energy during the period of no load." The now well-known Ilgner system meets the latter condition; it includes a Ward-Leonard motor transformer, consisting of a motor connected across the source of supply, which drives a heavy fly-wheel to store the energy during the period the winding drum is standing, and a continuous-current separately excited generator; the winding motor is also separately excited, and is supplied with energy from the generator, so that any speed can be obtained by varying the strength of the fields of the two latter machines. The following particulars of the Zollern II. colliery winding engine on this principle, may be of interest:—Supply, 520 volts direct current; fly-wheel 12½ ft. diameter; weight, 45 tons; maximum peripheral speed, 13,600 ft. per minute; revolutions per minute, 300 to 345. The motor-generator takes 600 amperes to start, and after 10 minutes takes 100 amperes light When winding, the primary current varies between 250 and 450 amperes; 5 tons of coal are raised per wind, the lift of 330 yards being made in 43 seconds; the maximum speed is 1,980 ft. per minute. The periods of rest are as long as 45 seconds, against 12 to 15 seconds occupied in some of our best collieries.

(To be concluded.)

NEW PATENTS APPLIED FOR.

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23,241. "Improvements in laying electric conductors." J. H. C. Brooking. November 13th.

23,267. "Momentum engine and electrical self-generation dynamo and motors." B. C. Pole. November 13th.

23,298. "Improvements in and relating to electrical safety devices for guarding against burglary and the like." C. Jacob. November 13th. (Complete.)

23,312. "Improvements in connection with the electro-deposition of copper and other metals." S. O. Cowper-Coles. November 13th.

23,313. "Improvements in removing metallic cylinders from mandrels on which they are electro-deposited." S. O. Cowper-Coles. November 13th.

23,318. "Improvements in connection with mercurial vapour lamps." J. Y. Johnson. (The firm of W. C. Heraeus, Germany.) November 13th.

23,320. "Improvements relating to sockets for receiving electric lamps, plugs and the like." F. Millington and A. H. Miller. November 13th.

23,328. "Improvements in electrical conduit tubing joints." A. H. Hoar. November 14th.

23,379. "Improvements relating to pendants or like supports for electric lamps." H. C. Smith. November 14th.

23,402. "Improvements in electric furnaces." P. Girod. (Date applied for under Patents Act, 1901, December 24th, 1904, being date of application in France.) November 14th. (Complete.)

23,437 "Improvements in and relating to incandescent electric lamps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 15th.

23,438. "Improvements in and relating to electric distribution systems." The British Thomson-Houston Co., Ltd. (The General Co., United States.) November 15th.

23,440. "Improvements in and relating to electric distribution systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 15th.

23,441. "Improvements in and relating to electric railways." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 15th.

23,442. "Improvements in and relating to methods of manufacturing incandescent electric lamps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 15th.

23,446. "Divers' and miners' portable and electrical lamp." W. Dentith and H. Midgley. November 15th.

23,449. "Electric working of mine shafts." J. Swinburne. November 15th.

23,451. "A combined electric and automatic self-locking double railway carriage lock and spindle adaptable, final fastener unpickable and burglar-proof." H. Taylor. November 15th.

23,474. "Improvements in and relating to the electro-deposition of metals, alloys, and the like." M. K. D. Roberts and E. W. Jaffray. November 15th.

23,526. "Improvements relating to electrical furnaces." B. Platschick. November 15th.

23,547. "An improved method of fixing the grooved casing covers as used for the wires in electric lighting." W. Mills and F. T. Paine. November 16th.

23,553. "Improvements in electric motors and similar dynamo-electric machines." Veritys, Ltd., and P. A. Hirsch. November 16th.

23,561. "Improvements in electricity motor-meters." G. Hookham. November 16th.

23,569. "Improvements in electric accumulators." E. Bailey, W. Plews and T. W. Anderson. November 16th.

23,582. "Improvements in electrical switches." W. McGeoch & Co., Ltd., and W. L. Barber. November 16th.

23,584. "Improvements in electric motor apparatus applicable to machinery of all kinds requiring force." T. J. Howell and E. J. Richardson. November 16th.

23,619. "An improvement in microphones." C. D. Abel. (Siemens & Halske Aktien-Gesellschaft, Germany.) November 16th. (Complete.)

23,624. "Improvements in electric circuit-breakers." The Felten and Guilleaume-Lahmeyer-Werke Aktien-Gesellschaft. (Date applied for under Patents Act, 1901, December 22nd, 1904, being date of application in Germany.) November 16th. (Complete.)

23,656. "Improved top electric rollers for electric stop motion frames." A. Broadbent. November 17th.

23,661. "Improved arrangement for the regulation of speed of compensated single-phase motors." E. Arnold and J. L. La Cour. (Date applied for under Patents Act, 1901, November 21st, 1904, being date of application in Germany.) November 17th. (Complete.)

23,662. "An expanding terminal connection for electric cables and the like." C. H. Robinson. November 17th.

23,720. "Improvements in and relating to transformers and the like." A. P. Zanl. November 17th. (Complete.)

23,722. "Improvements in and relating to systems of connections for telephone offices, with separated plug-service and means for signalling, whether an operator is unoccupied or engaged." Deutsche Telephonwerke R. Stock and Co., G.m.b.H. (Date applied for under Patents Act, 1901, November 17th, 1904, being date of application in Germany.) November 17th. (Complete.)

23,738. "Improvements in or relating to commutators and the like." H. A. Mavor and Mavor & Coulson, Ltd. November 17th.

23,751. "Improvements in brush contacts for electric switches." W. H. Scott. November 17 h.

23,753. "Improvement in electrical apparatus for regulating clocks." R. J. Rudd. November 17th.

23,756. "A new or improved junction box for electric cables." E. W. Hill. November 18th. (Complete.)

23,838. "Improvements in and relating to apparatus for changing the frequency of alternating electric currents." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 18th.

23,839. "Improvement in dynamo-electric machines." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 18th.

PUBLISHED SPECIFICATIONS.

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Safety Fuse Apparatus for Electrical Installations. J. Hartig. 17,800. September 2nd.

Electro-Magnetically Controlled Fluid Pressure Motors. E. de M. Malan. 209. January 4th.

Electrical Condensers. J. Rymer-Jones. 1,136. January 20th.

Controller and Brake Mechanism for Electrically-Driven Road Vehicles. S. A. Russell and E. Ford. 1,732. January 28th.

Electric Signalling Apparatus. Evershed & Vignoles, Ltd., and S. Evershed. 3,076. February 14th.

Electrical Switches. E. Tyer. 3,265. February 16th.

Electrically Operated Tubes or Bulbs Containing Rarefied Gas or Vapour. F. W. Howorth. (The Moore Electrical Co.) 5,866. March 20th.

Electric Lamps for Illuminating Time Pieces and for other Uses. J. C. Vickery. 6,053. March 22nd.

Gas Proof and Disconnecting Plug for Electrical Switches. A. E. Carter. 8,127. April 17th.

Telephone Mouth Pieces. R. Knoll. 12,406. June 15th.

Electric Drills. A. J. Boult. (W. O. Duntley.) 13,093. June 24th.

Method of, and Means for, Supplying Current to Branch Stations of Telephone Exchanges. Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges.) 13,586. July 1st.

Apparatus for Electric Welding. H. H. Lake. (The Clinton Wire Cloth Co.) 14,780. July 18th.

Fusible Electric Cut-Outs. British Thomson-Houston Co., Ltd. (General Electric Co.) 402. January 9th.